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Private Construction Recovering

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LET no one tell you that the Federal Housing Administration is not getting results.

After nine months of existence, this governmental agency has created a large volume of business for the building industry, and it is still going strong.

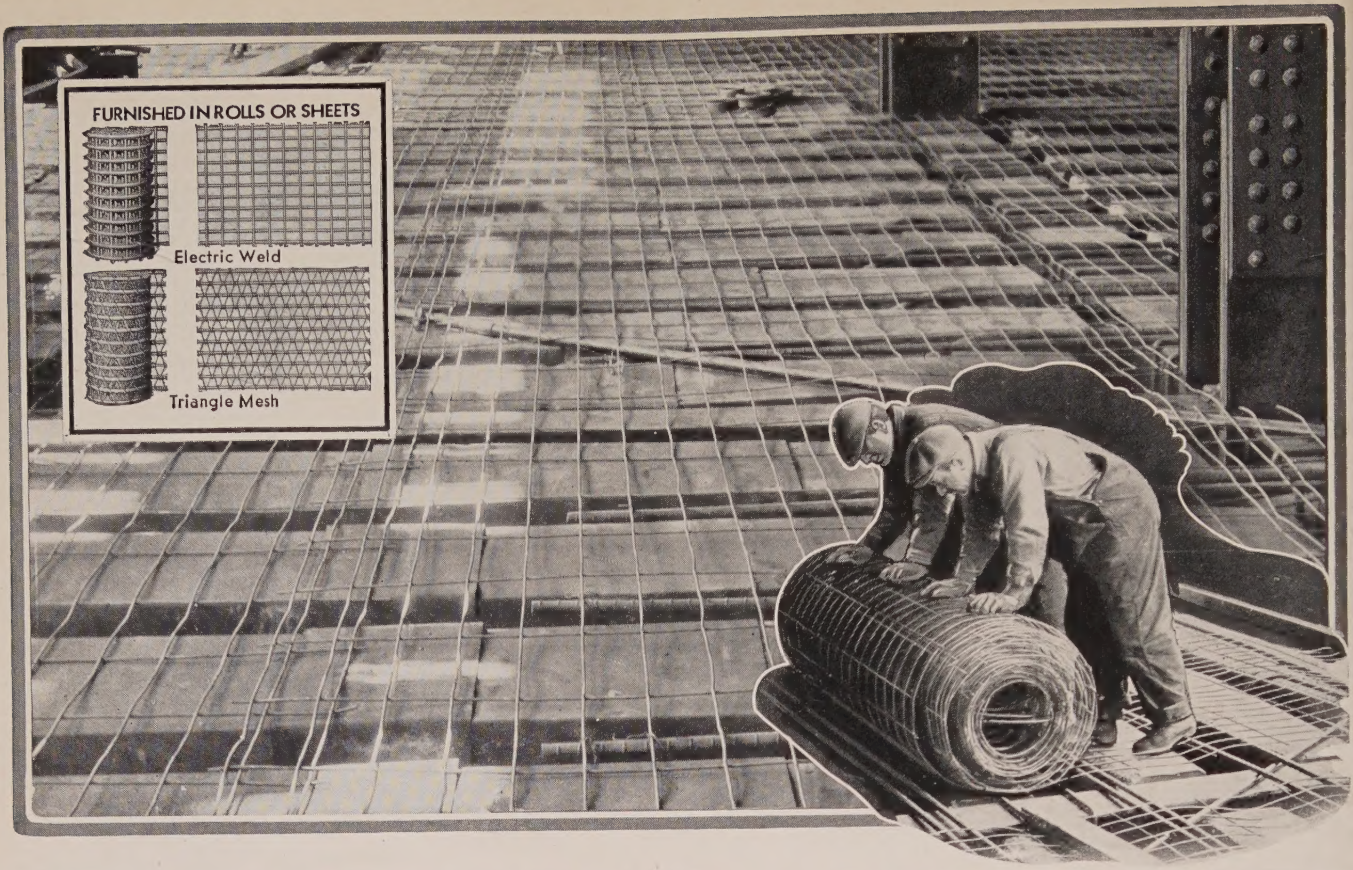
A check-up as of May 18 shows that property owners throughout the country had pledged, under the stimulus of the better-housing program, more than 400 million dollars' worth of modernization and repair work. The majority of pledgers are paying cash for these improvements, so that only 69 millions of credit had been advanced.

Community campaigns to the number of 7,626 had been organized by May 18, no less than 159 having been added during the week ending on that date—thus proving that this stimulating movement is still very much alive.

The good results achieved are being reflected in other directions—as, for example, in the substantial increases in building permits for new residential construction revealed by figures from the Bureau of Labor Statistics.

Observe also the large increase in all types of building construction, including residential construction, throughout the southern states, reported on page 28 of the May issue of "Concrete."

In many other directions private construction is showing definite signs of recovery—and for the stimulant that set this recovery in motion, FHA deserves a generous measure of credit.



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Theatrical Concrete Ashlar

Gets a Curtain Call and Bows Gracefully to Appreciative Audiences in Detroit—Colorful Interiors

ENOUGH work has already been done to justify the early promises of concrete ashlar for theater construction and interior finish. Structurally, decoratively, and acoustically, light-weight concrete ashlar has been recognized as the first real development in theater building since the sound film raised the movies from dark room shadow play to living drama. Catching on first as economical acoustical treatment in theater modernization, it has now spread to new construction. In this latter field ashlar is destined to play a large and important role in the development of a new type of American theater.

Triple Service from Concrete Ashlar

The Tower Theater in Detroit, opened last December, is a modern and strictly American show house. No candied bric-a-brac and gaudy hangings greet the customer entering the spacious foyer; no gilded gingerbread or other ostentatious false work adorn its auditorium walls and ceiling. As function dictates the form of the building, so does it determine the detail, for this theater is designed to afford the most direct view of the stage and to bring sound clear and undistorted to the remotest seat in the house. The ashlar walls that make its simple, direct design charming and its acoustics almost perfect are also the structural bearing walls of the building. The economy of this triple role played by concrete ashlar is naturaly attractive from the standpoint of construction costs.

The building is a combination of steel frame and of wall-bearing masonry. In general, the walls are of hollow concrete masonry units of stock sizes, faced on the exterior with hard burned common brick except at one frontage where "Macotta" forms the finish treatment. The hollow concrete units of portland cement with blast-furnace slag used as aggregate, become also the interior wall surfaces of the theater.

The hollow concrete wall units were selected for three reasons; first, the pleasing texture of the surface eliminated the need for plaster or other wall finishes other than paint, thus tending toward economy; second, the porosity of the units provides relatively high sound absorption, highly desirable for acoustical perfection; third, the hollow spaces in the wall retard thermal conductivity, make heating and air conditioning more economical.

Colorful Interior

Passing from the entrance, patrons enter the vestibule, whose slag block ashlar walls are decorated in a dark chinese red. The sand finish plaster ceiling here is stenciled in blue, red and black with fields of silver, gold leaf and blue. Molded glass, set flush with the ceiling in dull nickel silver frames, allows light from concealed lamps to illuminate the room.

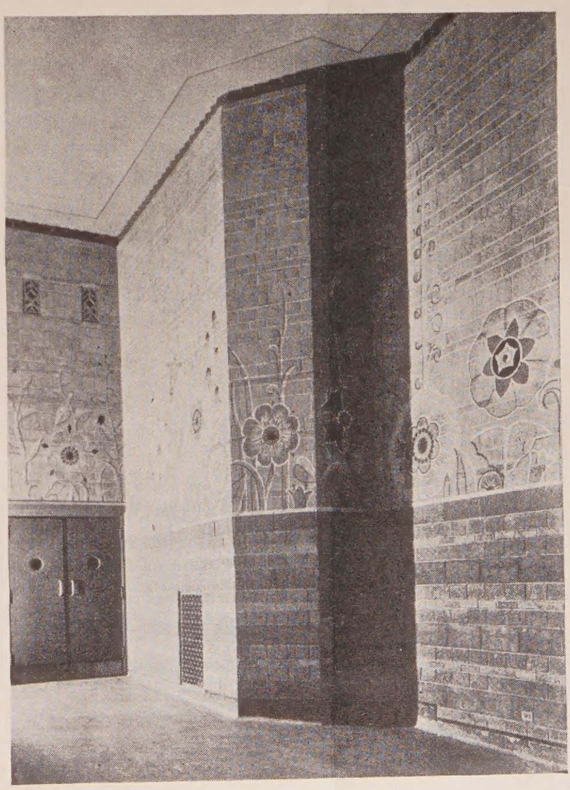
The lobby floor, rising gradually from vestibule to foyer, has an average ceiling height of 21 ft. The walls are slag ashlar units of three standard heights—8 in., 4½ in. and 2½ in., repeating in horizontal bands throughout the entire height of the wall. The dado, about 7 ft. high, is painted two tones of blue and orange, thus accentuating the horizontal bands. A painted silver stripe separates the wainscot from the light blue wall above. Superimposed over the blue background is a very modern, conventionalized floral pattern, mural in character. The lobby wall is topped with a course of saw-toothed slag units, specially designed for decorative bands throughout the theater by the architect, Arthur K. Hyde, of Detroit. These units are shown in position in Fig. 1, while the method of their manufacture is shown in Fig. 2.

Semi-indirect modern lighting fixtures illuminate the low-ceilinged but wide and spacious foyer. The ashler walls here are of 8 by 8 by 16-in. slag units, each two courses of which are separated by the saw-tooth course of the same material. Two shades of rose were used for wall color, contrasting agreeably with the black doors with silver stripes. The lowest course, painted black, separates the light shades of the wall from the autumnal color of the deep piled carpet over the entire floor.

A Horizontal Motif

The auditorium is 89 ft. by 110 ft. from the proscenium to the back of the house, with an average ceiling height of 27 ft. The 1,442 seats are arranged in three sections with two center aisles.

Fig. 1. Portion of lobby wall where three sizes of regular slag concrete ashlar units were laid up in alternating courses to form a pleasing background for the colorful flower murals. Arthur K. Hyde, architect



The slag concrete ashlar walls of the auditorium are laid up in the same course design as in the foyer, and curve gently in with a large radius stopping at wide masonry pilasters that frame the proscenium arch, which is 43 ft. wide and 22 ft. high. It is in the auditorium that the saw-tooth courses acquire their true importance. Not only do they add interest, relieving the monotony of the standard unit courses which might be evident in a wall of such area, but they produce a horizontal striping that improves the scale of the wall; and the indentures give a three-dimensional effect.

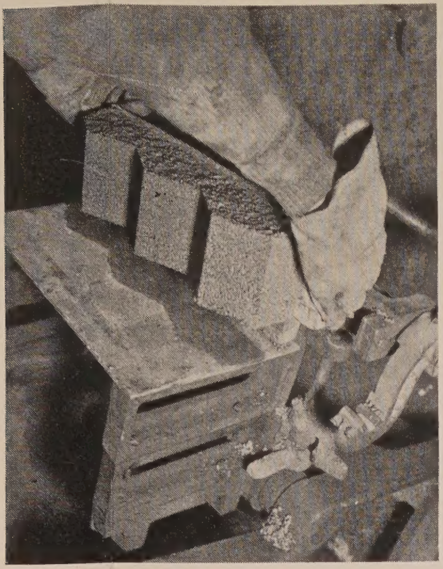


Fig. 2. A special mold is used in the regular block machine to manufacture the new saw-tooth slag ashlar unit developed by the architect, Arthur K. Hyde

The horizontal motif is carried out in the decoration on the auditorium wall and ceiling. Every third flat surface between the saw tooth bands is painted with a repeating stencil pattern. The resulting effect of alternating narrow and wide bands accentuates the length of the wall and leads attention to the stage. Ceiling decoration is tastefully simple. The center panel, lying between two beams each 4 ft. wide is flat, while the side panels slope up to the beams from the walls. These ceiling panels are decorated in a light buff with darker edges. The beams are ultramarine blue with stenciled ornaments in orange, black and red on the soffits connecting the openings for light panels and heating grilles.

Casting the Saw-Tooth Units

The saw-toothed ashlar units, which are so important to the design effects of Tower Theater's walls, were specially developed by Arthur K. Hyde, the architect, at the Detroit plant of the Standard Building Products Co. A special steel mold is used for casting the units. The effective use of these irregularly-shaped ashlar units opens wide the possibilities for the future. There is no limit to the variety of shapes and forms these designs might take, adding new beauty and individuality to the already popular patterns of coursed and random ashlar. The theater, which has been quick to seize new opportunities during the past few years, is a logical place to develop many new uses for this attractive, durable and economical material.

Flexural Tests of Mortar Beams

AFTER tests on the effect of temperature and moisture on the flexural strength of portland cement mortar beams, conducted by the U. S. Bureau of Public Roads on specimens aged 28 days and 2 years, it was decided to make further tests on beams with preliminary curing of 90 days in water instead of 28 days. Six 2 by 3 by 16-in. beams, 1:2 mix by weight, were prepared on each of 12 days and stored for 90 days in water. Three of each set of six beams were removed at 90 days and dried to constant weight at a temperature of 150 ± 5 deg. F. At the age of 103 days, both the wet and dry beams were tested in a cantilever machine for flexural strength at temperatures of 40 deg., 70 deg., and 100 deg. F. The average strength results were as follows in lb. per sq. in.

	Beams, Dry	
40 deg. F.	70 deg. F.	100 deg. F.
1,379	1,309	1,259
	Beams, Wet	
40 deg. F.	70 deg. F.	100 deg. F.
956	901	646

The following conclusions are given as warranted by the results of the tests:

1. Increase in temperature of mortar beams at time of test results in a reduction of flexural strength.
2. The effect of the temperature of a mortar beam at time of test on the flexural strength is more pronounced in the case of beams tested in a wet condition than with oven-dried beams.
3. In these tests, the flexural strength of mortar beams tested in a wet condition appeared to be affected to a greater extent by a change in temperature from 70 deg. to 100 deg. F. than from 40 deg. to 70 deg. F.
4. Mortar beams tested in a dry condition show a uniform reduction in flexural strength with increase in temperature from 40 deg. to 100 deg. F.
5. Mortar beams tested in a dry condition develop higher flexural strength than beams tested in a wet condition, provided duplication in curing conditions has been attained.

The report, which was prepared by D. O. Woolf and K. F. Shippey, recommends that flexural tests be made with saturated specimens and at a temperature of 70 deg. F. plus or minus 5 deg. F.—From Highway Research Abstracts.

April Home Building Highest Since 1931

RESIDENTIAL building in the 37 states east of the Rocky Mountains during April was greater than for any other month since the close of 1931, according to the F. W. Dodge reports. The total of contracts for home-building for April was $42,000,000, as compared with $22,635,000 in the same month of last year and $32,209,000 for March, 1935.

The April total for housing facilities was about one-third of the total contract volume for all classes of construction. This is a significant development, since in the recent past residential building has formed a far smaller proportion of the volume than is customary for that branch of construction activity.

The total volume of construction of all classes in the 37 states east of the Rockies was approximately $124,000,000 for April. This compares with $122,940,000 for the same month in 1934. Private construction contracts were higher during April than for any other month since the end of 1931.

High Retaining Wall of Unusual Type

Greater Part of Lateral Pressure Eliminated—May Revolutionize Retaining Wall Design

A NEW and unusual type of retaining wall, in which the total lateral pressure from the retained material is greatly reduced, has been built by the Department of Parks of New York City along the express highway in Riverside Park between 72nd and 79th Streets. As in older types of retaining walls, the retained earth supplies much of the vertical load that holds the wall in place.

How Lateral Pressure Is Eliminated

Essential features of this wall are shown in the line drawing here reproduced. The wall consists primarily of a series of narrow reinforced concrete piers, spaced 16, 17 and 18 ft. apart, from center to center, and joined by a solid deck of precast reinforced concrete beams. These precast beams, as the drawing shows, support the upper portion of the retained strength. Below this deck, the retained material is allowed to take its natural slope, and no lateral pressure is developed. The only lateral pressure resulting from this arrangement is that exerted at the top of the wall—for a depth of about 4 ft. 6 in. in this case—and the slight horizontal pressure due to the sloping of the deck of precast beams.

The deck produced by the precast reinforced concrete beams is sloped to a grade of 1½ horizontal to 1 vertical, in order to conform to the slope of the earth fill behind the wall. By way of explanation, it should be added that this retaining wall is built along the New York Central Railroad tracks, to shut off the view of the tracks from the park, the retained ground being sloped off into the park. The structure that carries the express highway above the railway tracks is built independent of the retaining wall. The highway deck, however, is built at approximately the same level as the top of the wall, to which it is connected by a grating.

Where Retained Earth Is Level

If the surface of the ground retained by the wall were horizontal, the deck produced by the precast reinforced concrete beams would also be horizontal. That is, the precast beams would be placed side by side, all at the same level, instead of being stepped down to a slope. In such a case the designer should provide an apron wall at the rear edge of the piers, extending it from the beam deck down to about the level corresponding to the point *B* on the drawing. This apron wall may, if desired, be made with precast beams similar to those comprising the deck, but placed horizontally. In this instance, then, the only lateral pressure would be that exerted against the apron wall at the rear, and against the part appearing as an upward extension of the wall at *A*.

This apparent upward extension of the wall at *A* is, in fact, produced by two precast reinforced concrete beams, 23 in. wide and 24 in. deep, set one on top of the other and bedded in mortar. These two beams are anchored to the top of the piers by means of steel dowels embedded in the piers. Recesses in the ends of the precast beams fit around the dowels, and the space is filled with mortar.

Dimensions of Piers

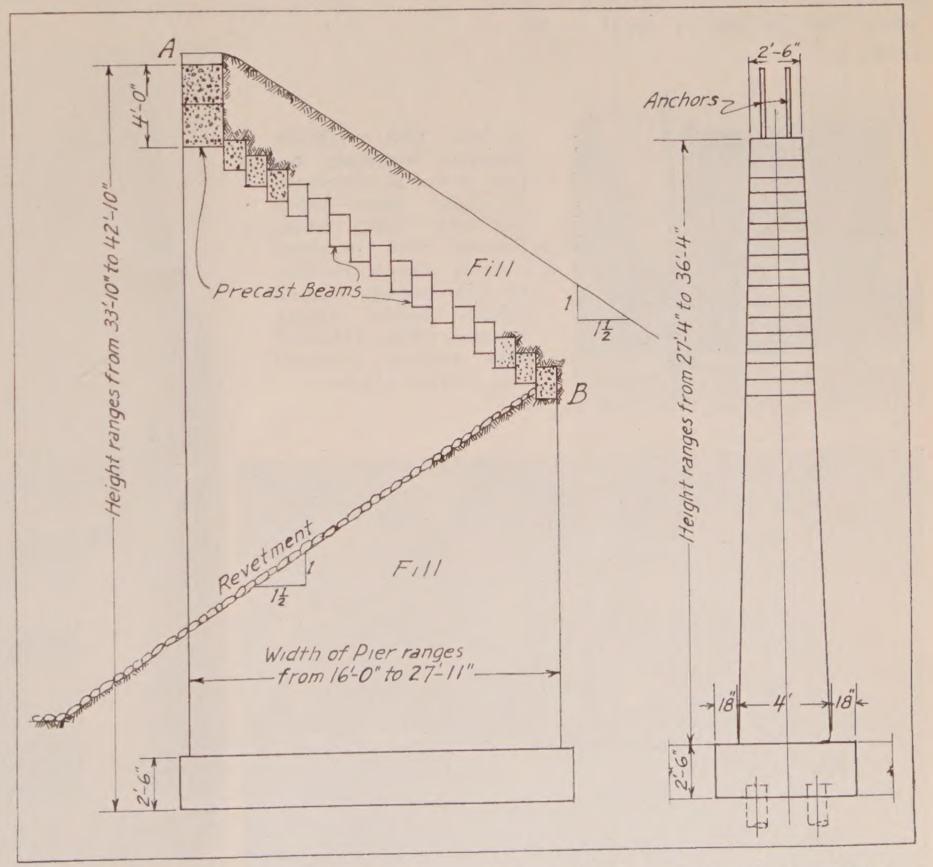
On this project the piers, 64 in number, are 2 ft. 6 in. wide at the top and 4 ft. wide at the footing. The footings are 2 ft. 6 in. deep and under a portion of the wall they form a continuous mat. In other sections of the structure the pier footings—2 ft. 6 in. deep and 7 ft. wide—are supported on piles, and are connected to each other by reinforced concrete struts 2 ft. 6 in. square.

Measured from the base of the footing to the top of the large precast beams at *A*, the total height of the wall ranges from 33 ft. 10 in. to 42 ft. 10 in. The dimension of the piers measured from front to rear ranges from 16 ft. to 27 ft. 11 in. It will thus be seen that this type of retaining wall is practicable for walls of great height.

Nothing needs to be added in regard to the analysis of loads and stresses, inasmuch as any competent structural designer will be able to compute the intensity and direction of loads and pressures.

Acknowledgments: The contract for

(*Continued on page 8*)


A
4'-0"
Height ranges from 33'-10" to 42'-10"
Precast Beams
Fill
1
1½
B
Revetment
1
1½
Fill
Width of Pier ranges from 16'-0" to 27'-11"
2'-6"
2'-6"
Anchors
Height ranges from 27'-4" to 36'-4"
18"
4'
18"
2'-6"

New type of retaining wall may revolutionize this form of engineering structure; showing (at left) cross-section of wall and side view of a typical concrete pier, and (at right) rear view of same pier

Another Before-and-After Modernizing Success

Dingy Old Brick Business Building in Milwaukee Modernized with Cement Stucco and Cement Plaster

A SMALL, drab-looking detached 2-story brick business building, standing at 3300 West National Ave., in Milwaukee, has just been completely modernized, both inside and outside, through skilful use of portland cement plaster and stucco. From the dingy and misshaped brick building that it was, it has been transformed into a property that is modern in appearance, pleasing to the eye, and a credit to its owner.

New Face on Old Brick

The new exterior facing was built up directly onto the old brick facing, by attaching wire mesh to the brickwork and applying a base coat and a finish coat of portland cement stucco.

For the finish coat a light-colored portland cement was used, together with mineral colors, and this coat was applied and shaped to represent coursed ashlar by the use of hand molds of metal.

Molding the Exterior

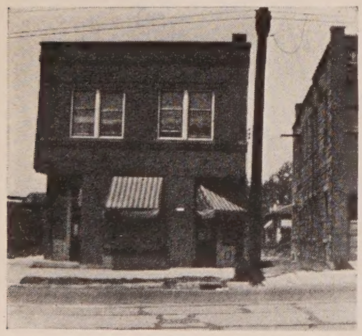
Much skill was required, of course, in the handling of these molds and in the placing of the final coat of exterior stucco. First, mineral colors of several slightly different color tones were sprinkled into the bottom of a mold, while it was held in a horizontal position. Then the mold was filled with stucco, which, of course, resulted in incorporating most of the mineral colors into the surface of the fresh stucco. The entire contents of the mold then were pressed firmly against the base coat, and the effect shown in the illustration was obtained. Through the use of several different molds, the usual coursed ashlar patterns were obtained.

A new and modern store front completed the modernization of the exterior.

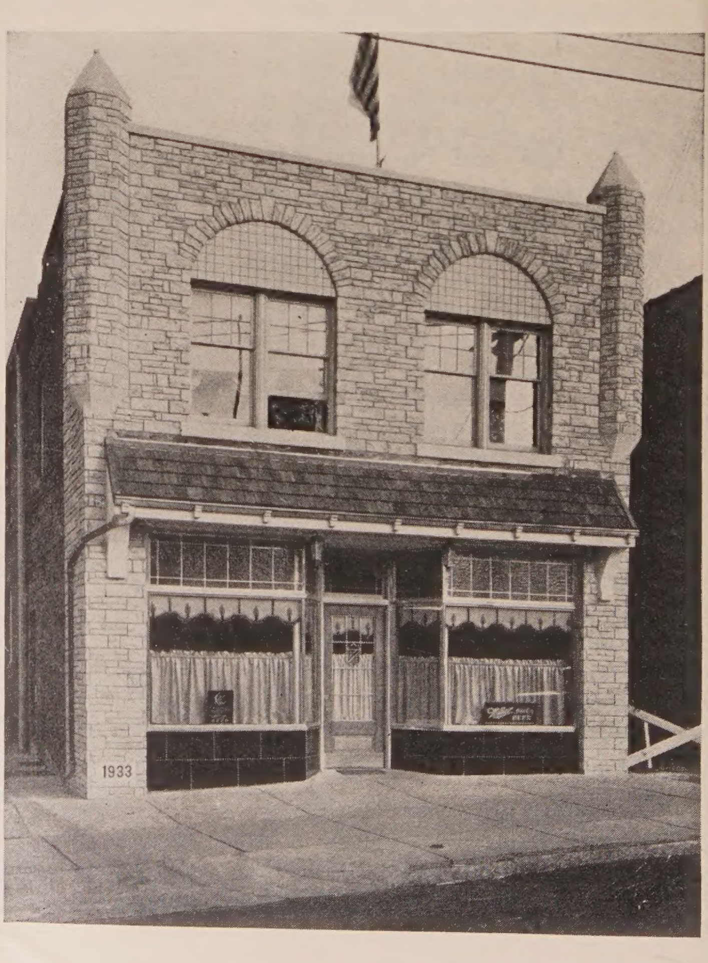
The interior view shown in one of the illustrations, has the appearance of a stained wood finish. This effect, however, was obtained entirely with portland cement plaster, which was stained to represent wood. Even the ceiling beams and the trim around the interior doorway were produced in this way. Both rooms on the ground floor are finished in this Alpine type of interior construction.

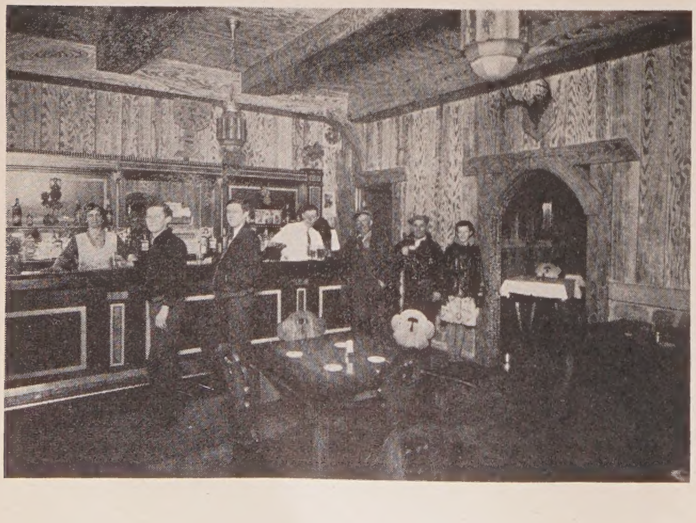
Referring again to the exterior, the results produced are of direct interest to manufacturers of concrete products. While this new facing is in fact a portland cement stucco, similar effects can be obtained with veneers of concrete ashlar units. The business sections of almost every town and city present similar opportunities for the transformation of old and outmoded brick buildings. In many cases the initiative of a local architect or building contractor will create remodeling work of this type.

Acknowledgments: For the information here given, and for the photographs from which the illustrations were made, CONCRETE is indebted to Matthew Udovc, proprietor of the Alpine Tavern, occupant of the building. The modernizing work, both exterior and interior, was done by the Northwestern Plastering Co., of Milwaukee.



At left: Old red brick business building, before it was modernized. At right: Same building after being transformed with portland cement stucco, molded to represent coursed ashlar. Below: Alpine interior effect obtained with stained portland cement plaster





New Web Reinforcement Simplifies Placing Problems

Continuous Strip Type of Web Steel Urged in Place of Loose Stirrups—Design and Inspection Also Much Easier

By WILLIAM FLESHER
Structural Engineer, 5411 Berks St., Philadelphia, Penna.

The writer believes that he is here presenting the solution of the troublesome problem of web reinforcement—a solution that he has used successfully on several concrete construction jobs.

It is not a patented scheme, nor is there any intention of obtaining patents on the idea. The article is offered with the thought of drawing attention to this continuous type of web reinforcement, and obtaining comments or opinions from others.—The Author.

WEB reinforcement for concrete beams has always been a source of annoyance to the writer. I have designed reinforced concrete structures, detailed the placing plans, fabricated the bars, placed the reinforcement, and worked as inspector at various times in my career. In every instance I found loose stirrups a difficult problem. The designing was often barely more than a guess, due to the time element. Detailing of stirrups involved dealing with many variables such as depth, width, size, and the way in which the hooks were to be bent. An error in any of these caused trouble somewhere further down the line, and it sometimes proved very costly.

Fabricating was a slow and tedious matter with the probability of error, as in detailing. Placing involved far too much effort for the conscientious placer, and after a great deal of trouble had been taken there was no assurance that the stirrups would be in their proper places when concrete was deposited. Inspecting and checking on stirrups was a nightmare to the diligent inspector. A typical floor layout of about 8,000 sq. ft. involves 30 to 40 different beams and girders, each with its own stirrup arrangement. Conscientious checking of spacing and position of the stirrups is irksome. The speed at which concrete is placed left very little time to avoid being engulfed.

Why Have Loose Stirups?

In view of all of this bother, the writer raises the question "Why have loose stirrups?" Frankly, I see no good reason for clinging to this source of vexation, particularly since there is a simpler and more logical way of taking care of diagonal tension stresses. A continuous bar bent into a strip as shown in Sketch 1 is the writer's idea of sanity in web reinforcement. It provides accurate distribution of steel to take the stresses where they occur. Designing is accurate and simple. Detailing is free of the possibilities of errors that exist with loose stirrups. Fabricating is cheaper and easier. Placing takes only a fraction of the time that is necessary for loose stirrups. Inspecting of the continuous strip type of web reinforcement can be done at a glance.

Calculation for Continuous Stirrups

Following is a typical example of the use of this simple web reinforcement. Assume a beam of 20-ft. span, a uniformly applied load of 3,000 lb. per lin. ft., the beam fully continuous, and longitudinal bars with special anchorage to permit 60 lb. unit shear. Size 12 by 24 in.

Total and shear . . . . = 30,000 lb. = V
12 × 22 × 60 × 0.875 . . = 13,850 lb. = V_c

Difference = 16,150 lb. = V_s

16,150/3,000 = 5.375 ft. = Dist. out beyond which no web reinf. is required.

From Chart No. 1 a ⅜-in. rd. bar is good for 6,780 lb.

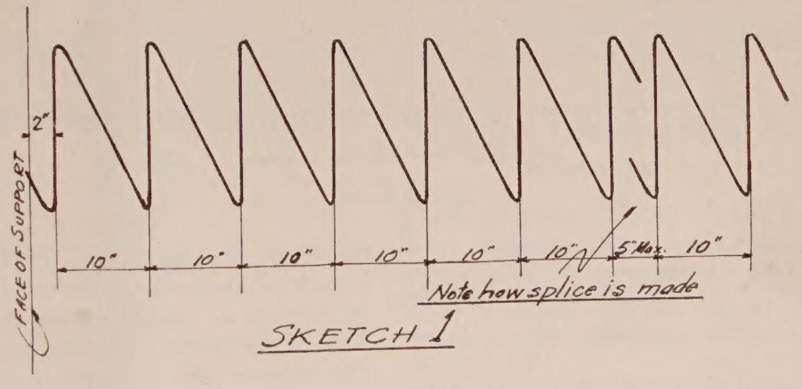
16,150 — 6,780 = 9,370
9,370 ÷ 3,000 = 3.12 ft.
9,370 — 6,780 = 2,590
2,590 ÷ 3,000 = 0.86 ft.

Required: 1 strip, 6 spaces, or 60 in. long.
1 strip, 3 spaces, or 30 in. long.
1 strip of two legs.
See Sketch 2.

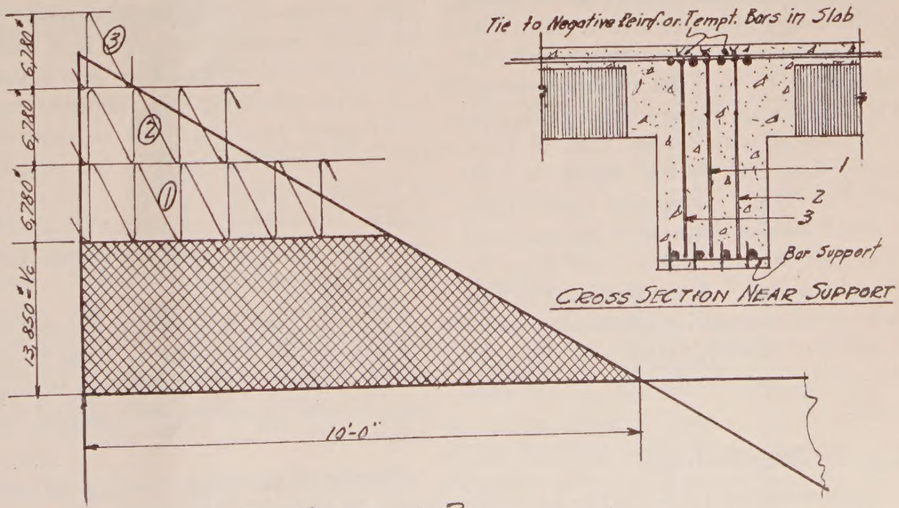
As a check, the total area of steel required for shear is

$$\frac{16{,}150 \times 5.375 \times 12}{16{,}000 \times 22 \times 0.875 \times 2} = 1.69$$

sq. in. This would require at least 8 stirrups, or 16 vertical legs. Above we have 20 legs acting to resist diagonal tension stresses. This



SKETCH 1


6,780#
6,780#
6,780#
13,850# = Vc
③
②
①
10'-0"
Tie to Negative Reinf. or Tempt. Bars in Slab
1
2
3
Bar Support
CROSS SECTION NEAR SUPPORT

SKETCH 2

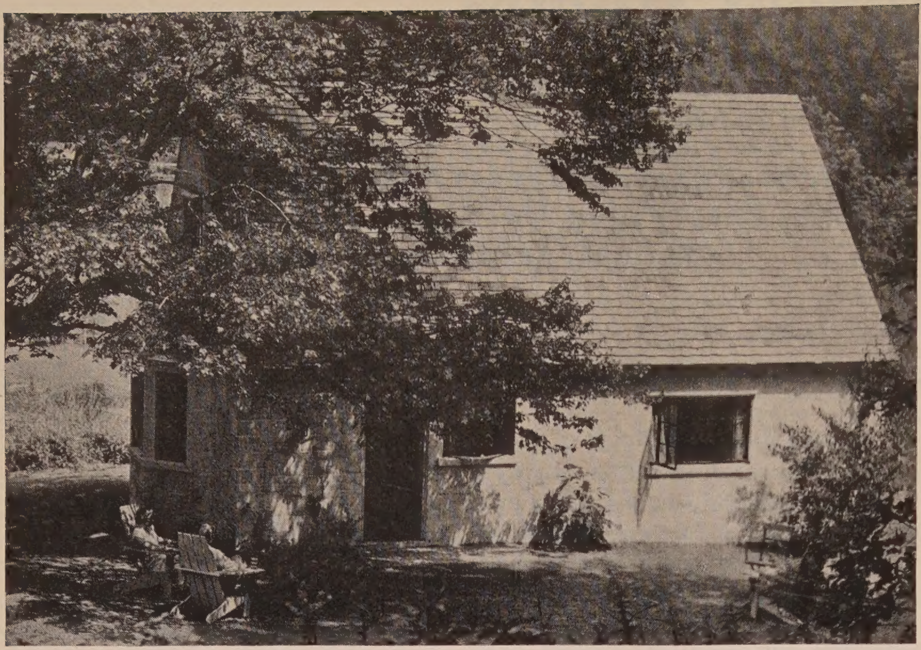


Fig. 2.—This "home-keeping house" at Westport, Conn., built of concrete ashlar and concrete first floor, cost less than $3,000, including heating and lighting and plumbing. Frank P. Bissell, architect

Low-Cost Homes a Fact

What, now, has been accomplished in the actual building of the low-cost fireproof concrete home? Have such homes been built at costs definitely below the costs prevailing during the building boom of the 1920's?

The answer to these questions is highly gratifying, for the year 1934, in particular, saw the construction of hundreds of modern homes at surprisingly low cost, through the simple expedient of taking full advantage of the properties of concrete and concrete products. In Miami Beach, Fla., for example, 200 of the 260 individual homes built in 1934 were of some form of concrete construction. A concrete home in Westport, Conn., illustrated in Figure 2, attracted 17,000 visitors and resulted in the sale of more than 100 sets of plans for a similar building. In one afternoon 4,600 adults visited a demonstration concrete home in Kansas City, and during a period of three weeks the number of visitors totaled 15,600. The house was sold on the second day. In Lexington, Mass., a 7-room concrete home of the Cape Cod type brought the architect two more commissions for buildings of a similar kind.

A Charming Home for $3,000

The 5-room home at Westport, Conn., illustrated in Figure 2 and mentioned previously as having attracted 17,000 visitors, is worthy of special attention. Designed by Frank P. Bissell and known as the *Woman's Home Companion* home, it was built by Martha Cobb Peabody, of the editorial staff of that magazine, for less than $3,000, including heating, lighting and plumbing. The exterior walls are of random ashlar cinder concrete masonry units 8 in. thick, the exterior and interior wall faces being coated with white portland cement paint. The first floor is of precast reinforced concrete joists and cast-in-place slab construction, with a finish coat of red portland cement mortar marked off in squares, and waxed. The second floor and the roof rafters, and the first and second-story partitions, are of wooden construction—a fact that is unfortunate, since partitions of 3-in. or 4-in. concrete ashlar units, and a second floor of precast concrete joists, would have added very little, if anything, to the cost. The roofing shingles are of cement-asbestos, and windows have steel sash.

The Floor Plan

The ground floor of the 5-room home just described has a spacious living room, modeled after the old-fashioned "keeping room" of our forefathers, with a large kitchen range occupying the center of one side and supplying not only the heat for cooking and for hot water, but for heating the whole house. In plan, this room is 13 by 20 ft.; and on this same floor is a bed room 12 by 12 ft., with a closet, a large entry and a bath room. Two bed rooms on the second floor are each 12 by 12 ft. in plan, each served by a closet.

An alternate plan of a more usual arrangement provides, on the ground floor, a living room 12 by 20 ft., a kitchen 8 by 12 ft., a pantry, and a bed room 12 by 12 ft., served by a closet. On the second floor is a bath room, and two bed rooms each 10 by 12 ft. in plan and each served by a closet.

More Low-Cost Homes

A somewhat more pretentious design is the home illustrated in Figure 3, designed by C. F. Rosberg, architect, for Charles G. Schmidt, of Lynbrook, Long Island, N. Y. This 5-room home and attached garage, built at a cost approximating $5,000, has walls of concrete masonry units. The exterior is finished with white portland cement paint, and the interior is finished in exposed cinder concrete ashlar furring block. The floors are of concrete.

Most of the 200 concrete homes previously mentioned as having been built

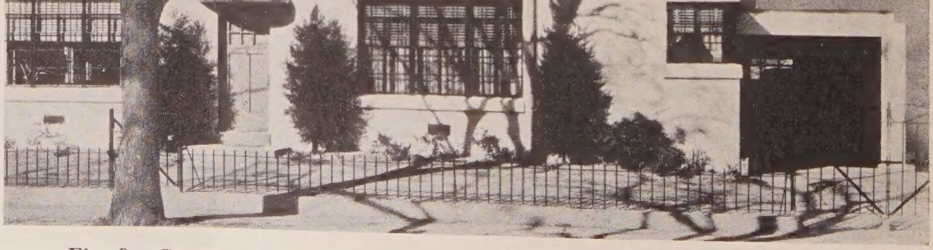


Fig. 3—Concrete home on Long Island, with five rooms and an attached garage, cost $5,000. C. F. Rosberg, architect

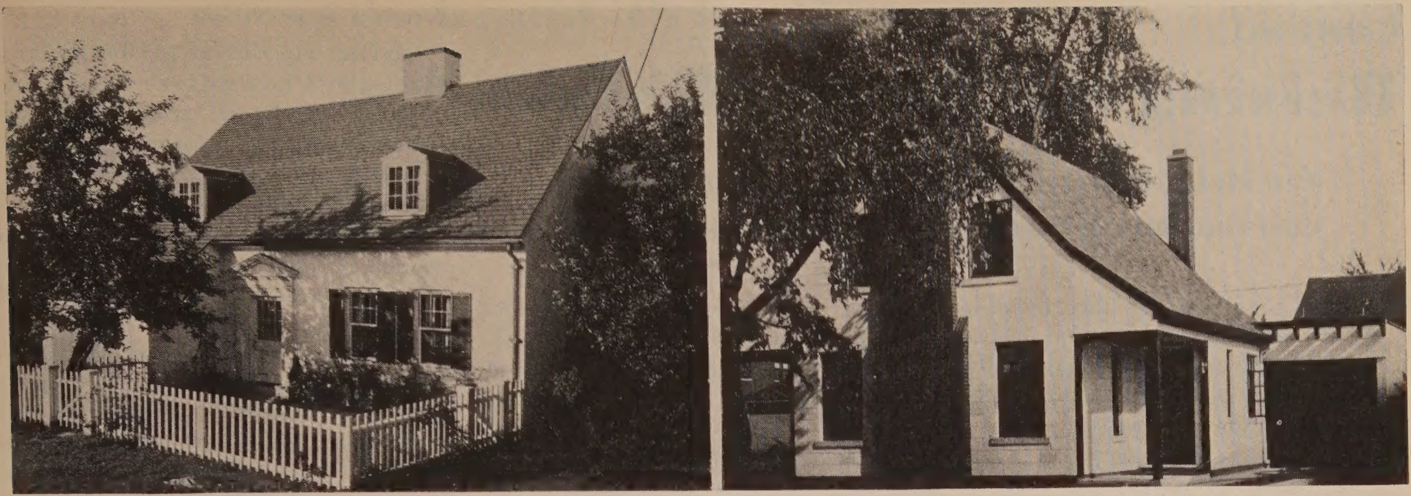


Fig. 4 (Left)—A 7-room concrete home and attached garage in Lexington, Mass., built at cost of $6,000, won two additional commissions for the architect, Charles M. Willis. Fig. 5 (Right)—Concrete house and attached garage in Detroit, built last year, sold for $4,000. Albert Bill, architect

in Miami Beach, Fla., during 1934, are practically 100 per cent concrete. The frames are of reinforced concrete, with concrete masonry filler walls. Floors and roof are also of concrete construction, mainly with precast members.*

Architect Wins More Commissions

Figure 4 illustrates a most charming 7-room concrete house of the Cape Cod type, designed by Charles M. Willis, architect, and built at Lexington, Mass., at a cost of $6,000, including the cost of a 2-car garage. The house has a full basement. The walls are of concrete masonry coursed ashlar units, 8 in. thick, and the outside surface was given two coats of white portland cement paint. This cottage attracted so much favorable attention that the architect received commissions to design two more houses of the same type, both of which were built with concrete ashlar walls and painted surfaces.

Detroit Home for $4,000

Figure 5 shows a small concrete home built in Detroit last year, which, together with the attached garage and the lot, was sold for $4,000. The walls of this house, which is located at 2725 Oakman Court, are built of coarsed concrete ashlar, the exterior surface being coated with white portland cement paint. Albert Bill, of Detroit, is the architect.

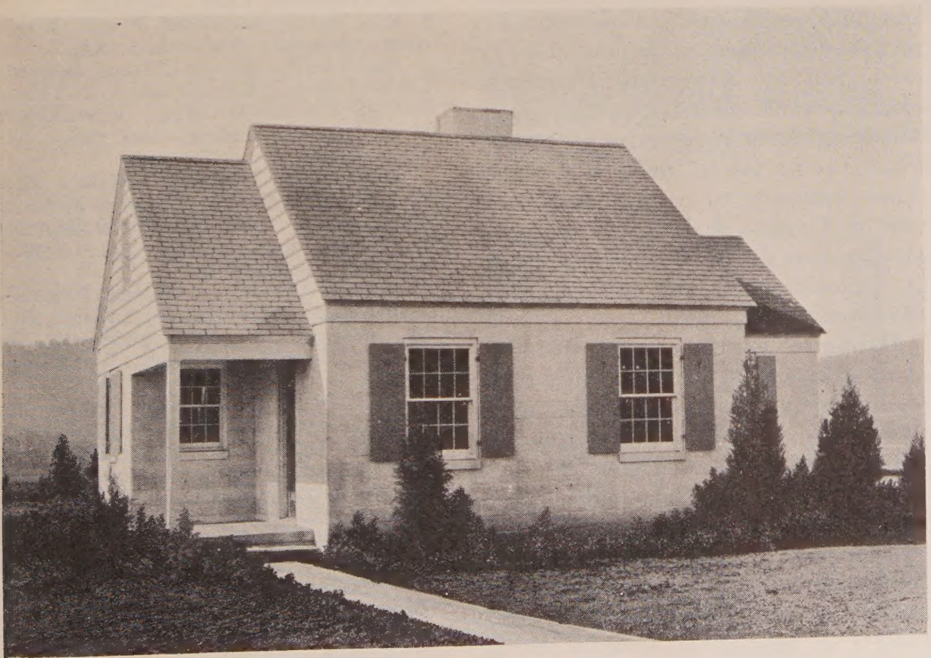


Fig. 6—One of a hundred concrete homes in Red House Gardens, West, Va., a government subsistence homestead project, being built at costs ranging from $1,800 to $2,500, including ¾ acre of land and a small barn

A 5-room concrete home of the modern flat-roof type, with a built-in garage, was built in Indianola, Iowa, in 1934 at a cost of $2,700, including heating, lighting and plumbing. Exterior walls and partitions throughout are of concrete masonry units, while the first and second floors and the roof deck are of precast concrete joist construction, all of which produces a completely fire-resistant type.

The Red House Home

A type of low-cost concrete home having great possibilities in connection with large developments is shown in Figure 6. This is one of a hundred of this type being built at Red House Gardens, West Va., in a subsistence homestead project of the federal government. This house has cinder concrete masonry unit walls, coated with white portland cement paint. The interior is finished with a colored mortar which is applied with a trowel and produces an interesting textured effect. These houses are costing from $1,800 to $2,500, though this price includes ¾ of an acre of land and a small barn. The living room, 11 ft. 6 in. by 18 ft. 8 in., is along the front. At the left rear is the combined dining room and kitchen, 10 ft. by 18 ft. 10 in. A bed room in the rear wing at the right measures 10 ft. 2 in. by 13 ft. 4 in., and between it and the dining room is a bath room. A stairway leads to a spacious unfinished attic, which provides ample sleeping quarters.

Thus it is demonstrated beyond question that modern fireproof concrete homes can be built at low cost, if the builder discards antiquated ideas and methods and utilizes the properties of concrete to the fullest extent.

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*This type of construction is to be described in detail in an early issue of CONCRETE.

Brookmire Sees Construction Revival

(Condensed from Brookmire Corporation Special Report, May 8, 1935)

MOST encouraging among recent economic developments is the pick-up in the volume of building. Activity in this industry fluctuates in great cycles, and a glance at the chart shows that the pendulum is swinging upward after the worst slump in the entire half century for which figures are available.

While the building booms occur about twenty years apart, and the next peak is not due until the late 1930's, the main trend from now on is likely to be upward; and a comparison of the present low point in the cycle with earlier periods suggests the amount of improvement lying ahead.

The subnormal rate of construction since 1929—the shaded area on the chart below the 100, or normal line—was necessary at first in order to permit absorption of the surplus structures erected late in the previous boom; but continuation of the subnormal rate has created a shortage. This condition was potential rather than actual as long as business activity remained low and the consumers' incomes were so poor as to compel families to double up.

Improvement in Residential Field

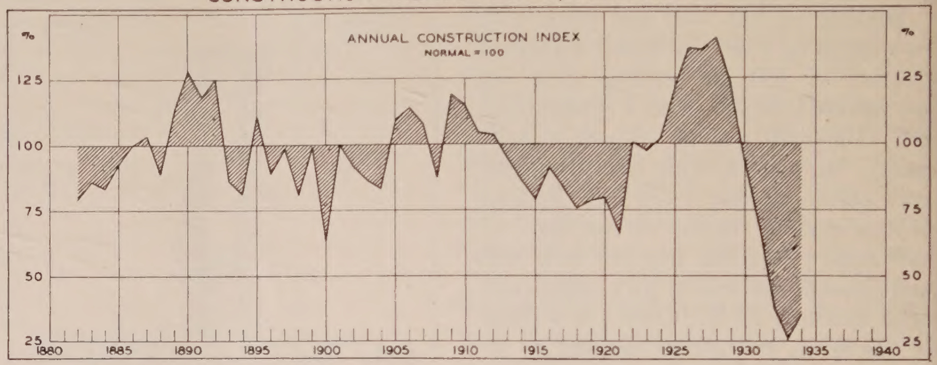
Economic recovery has already progressed far enough to alter this situation materially. Incomes have improved sufficiently to permit many families to afford separate quarters once more, and demand for residential space is being augmented further by the fact that marriages are again increasing.

Consequently there has been a rapid absorption of space. Indeed, shortages of single family dwellings have begun to appear over wide areas, and apartments in many cities are showing a gradual return to normal occupancy. For the first time since 1924, rents advanced in 1934, and the movement has continued persistently upward to the present time.

A large amount of repair or modernization work is also being undertaken on all kinds of structures. The encouragement given by the government to renovate homes is now being extended to industrial types, the limit on loans carrying Federal insurance being raised to $50,000.

Industrial building may revive sooner than generally expected. Ford has just added a big coke plant to his expansion program; other motor manufacturers and some major steel companies are also engaged in expansion, despite the fact that capacity has been considered notoriously excessive in these industries.

CONSTRUCTION TRENDS AND DEVELOPMENTS



Contract awards for public works have been at a low ebb since the last quarter of 1933, but the expenditure of nearly 5 billion dollars for work relief will mean increasing orders for building materials.

It must not be forgotten that building revival is the most important requisite for a broadening of the entire economic recovery.

A later Brookmire report, dated May 15, mentioned, as another favorable factor, the encouraging gains in building permit figures from all sections of the country.

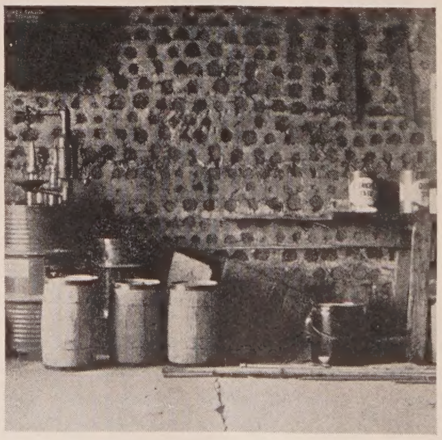
Logs and Concrete—

A New Kind of Masonry

THE Buick Garage at Marcell, Minnesota, has walls of small poplar logs held together by cement mortar. The logs are 8 in. long and the wall is 10 in. thick, giving the outside of the building a mortar face 2 in. thick. The ends of logs are exposed on the inside of the garage, making it easy to drive nails on which to hang tools and equipment. The illustration shows the inside face of the wall.

The garage was built in 1927, and the walls are in perfect condition today.

In constructing this wall, one course of logs was placed at a time, the corresponding height of cement mortar was placed around and over them, after which the next course of logs was placed.



"Masonry" of poplar logs embedded in concrete produces warm garage wall in Minnesota

This type of construction is reported to be exceptionally dry and warm. In spite of outside temperatures that frequently reach 40 deg. below zero, it never freezes inside the garage.

Leipzig Fair Dates Announced

THE Leipzig Trade Fair will be held from August 25 to 29, inclusive. It is assured that buyers from 74 countries will attend and that the newest art and industrial products of 22 great producing countries, including the United States, will be on exhibition. The historic Fair, which has been held without interruption for 700 years, is the largest as well as the oldest industrial exchange in the world.

Calcium Chloride Improves Cement and Concrete

Bureau of Standards Report Shows Favorable Influence of Material — Decreases Time of Hardening; Increases Workability and Strength of Concrete

DURING the past two years a fellowship has been maintained at the National Bureau of Standards by the Calcium Chloride Association for the purpose of studying the reactions of calcium chloride with cements and their constituents, and to obtain additional information as to the effect of calcium chloride on concretes made from present day cements.

The addition of calcium chloride appears to increase somewhat the heat contributed at the end of 24 hours by dicalcium silicate and tetracalcium alumino-ferrite and to decrease the heat contributed by tricalcium aluminate. Calcium chloride has but little effect on the heat contributed by tricalcium silicate. Calcium chloride increases the rate at which the heat is evolved from all cements. The strength contributed by the two silicate compounds in cement were increased and the strength contributed by tricalcium aluminate was decreased by the addition of calcium chloride. Calcium chloride decreased the time of set of eleven commercial cements and increased the flow and the strength of the resulting concrete. The physical properties of the experimental cements were similarly affected by the addition of calcium chloride.

Sixty experimental cements of varying composition and four commercial portland cements were furnished by the Portland Cement Association Fellowship at the National Bureau of Standards for certain heat and strength studies. The cements furnished by the association were ground to the fineness of 12.5 per cent retained on the No. 200 sieve.

The calcium chloride used was a standard commercial product complying with the American Society for Testing Materials, Standard Specification D98-34. The amounts added to the cement are reported as percentages of anhydrous calcium chloride by weight of cement.

The values obtained from these experimental cements show the same trends as those reported by Blank[1] and by Wood, Steinour and Starke[2], namely, that tricalcium aluminate ($3CaO.Al_2O_3$) gives the greatest heat evolved (expressed in calories for each per cent present in each gram of cement), tricalcium silicate ($3CaO.SiO_2$) being next in order. Calcium chloride appears to increase somewhat the heat contributed by dicalcium silicate ($2CaO.SiO_2$) and tetracalcium alumino-ferrite ($4CaO.Al_2O_3$), and to decrease the heat from tricalcium aluminate. The heat contributed by tricalcium silicate shows very little change when calcium chloride is added.

Commercial Cements

The standard evaluation tests for portland cement were made, except that 2-in. mortar cubes were substituted for briquettes. In these tests, 0, 0.5, 1, 1.5 and 2 per cent anhydrous calcium chloride, respectively, were added to the gauging water.

Concrete was tested in the form of 6 by 12-in. cylinders made from a 1:2:4 mix, by volume, with local sand and gravel. The amount of water (6.5 gallons per sack) used for gauging gave a cement-water ratio of 1.73 by weight, and contained, respectively, 0, 1, 1.5 and 2.25 per cent of anhydrous calcium chloride by weight of the cement.

Results: The results of the tests show that the mortar containing 1.5 per cent of anhydrous (2 per cent commercial) calcium chloride has a strength approximately 15 per cent greater than the plain mortar at one year; the strength at one day is practically doubled by the use of 1.5 per cent anhydrous calcium chloride. The strength of the mortars containing white cement was similarly affected by calcium chloride.

The compressive strengths of the concrete tests of the standard cements are summarized in Figure 9. The concretes with all percentages of calcium chloride have greater strength than the plain concrete at all ages tested. At one day the average strength of the concrete with 1.5 per cent anhydrous (2 per cent commercial) calcium chloride was 128 per cent higher than the average strength of the plain concrete. At 28 days the increase was 13 per cent; at 90 days 9 per cent; and at one year, 8 per cent. While calcium chloride produces the greatest acceleration at early ages, it likewise increases the strength of the concretes up to one year, at which time the tests were terminated.

Tests made by the Highway Department of the District of Columbia[3], the Portland Cement Association[4] and the Calcium Chloride Association Fellowship at the National Bureau of Standards, show the percentage increase in the compressive strength of concrete due to the addition of 2 per cent of commercial calcium chloride. These tests show that calcium chloride not only greatly increases the early strength, but it also increases appreciably the 3-year strength of the concrete.

The strengths of the mortars were increased for all percentages of calcium chloride added for the three storage conditions. At one day the strengths of the 40, 70 and 90 deg. F. specimens were increased 300, 145 and 90 per cent, respectively, by the addition of 1.5 per cent of anhydrous (2 per cent of commercial) calcium chloride. At three days the percentage increases were 117, 68 and 41 for the respective curings. At seven days calcium chloride increases the strength of the 40, 70 and 90 deg. F. curings 75, 32 and 23 per cent, respectively, but the 28-day strengths are increased only 20, 12 and 15 per cent with the addition of 1.5 per cent of calcium chloride. At 90 days the percentage increases were 10, 14 and 16 per cent for the respective curings. Thus, it is seen that the greatest increase in strength due to the addition of calcium chloride is obtained at low temperatures and early ages.

Plasticity Tests

During the molding of both the mortar and concrete specimens greater ease of placing was noted when calcium chloride was incorporated in the mix.

There was an increase in the average flow from 29 to 41 with the addition of 1.5 per cent of anhydrous calcium chloride. This increase in flow indicates increased workability. Thus by

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Condensed from paper presented by Paul Rapp before Fourteenth Annual Meeting of Highway Research Board, Washington, D. C., December, 1934.

adding calcium chloride less water may be used and a flow equal to that of plain concrete may still be obtained. Therefore, not only an increase in strength due directly to the addition of calcium chloride, but also a further addition in strength due to a decreased content of mixing water, can be obtained.

The strength of concrete, particularly at early ages, decreases very markedly as the temperature approaches the freezing point. Thus the lower the temperature, the more effective is the use of calcium chloride as an admixture to produce early strength.

There is an added advantage of using calcium chloride in cold weather in the increased rapidity with which it causes the development of heat. Construction at low temperature requires special measures to assure a rate of hydration of the cement that will develop early strengths. In thin concrete slabs, where the heat may be readily dissipated, this increased rapidity of development of heat will compensate for some of the heat lost and will decrease the curing time and the time necessary for the use of coverings, or other means of maintaining a satisfactory temperature for hydration.[5, 6]

At 40 deg. F. the standard portland cement concrete attained the safe compressive strength in 14 days, and the high-early-strength cement concrete in 5 days. Upon the addition of 2 per cent of commercial calcium chloride this same strength, at the same temperature, was attained with the standard cements in 7 days and with high-early-strength cement in 3 days.

At a curing temperature of 70 deg. F. the standard cement concrete required 6 days and the high-early-strength cement concrete a little less than 2 days to attain the designated strength. The addition of 2 per cent of commercial calcium chloride to the standard cement and 1.5 per cent to the high-early-strength cement reduced these respective periods to 2½ days and approximately 18 hours.

At 90 deg. F. the standard portland cement concrete attained the strength of 2,500 lb. per sq. in. in 4 days and high-early-strength cement in 1 day. The use of 1.5 per cent of calcium chloride produced this strength in 2 days with standard cement and in approximately 12 hours with high-early-strength cement.

Lerch and Bogue,[7] in a study of the Heat of Hydration of Portland Cement Paste, found that higher initial temperatures accelerate the reactions of hydration and increase the quantity of heat liberated from the cements at early ages. As the initial temperature is increased the maximum temperature attained is increased, and the time required to reach the maximum temperature is decreased.

Added to this accelerating effect of the higher temperatures is the accelerating action of calcium chloride, which is of equal importance to the acceleration caused by raising the temperature from 70 to 95 deg. F. Therefore, when calcium chloride is added to cement at a higher temperature, two accelerating actions, which are additive, are superimposed. Several investigators have shown that there is a direct relation between rate of heat evolution or temperature rise and the rate of hardening or set. Too great an increase in either, or both, of the accelerating factors, therefore, is likely to cause a time of set so rapid that finishing of the placed concrete would be difficult.

Summary

(1) As we consider groups with greater amounts of heat liberated, the increase in heat resulting from the addition of calcium chloride becomes less, until in that group liberating from 70 to 80 calories per gram the addition of calcium chloride lowers the amount of heat liberated 2 calories per gram.

(2) The study of the mortar strengths of 60 experimental portland cements of widely varying compositions at ages up to 28 days, beyond which no measurements were made, shows:

(a) Corroborating the findings of other investigators, the compound composition of portland cement greatly influences its strength. The strength contributed by each of the four major components has been computed.

(b) Calcium chloride increased the strengths of cements in mortars, especially marked when the composition was within the range encountered in commercial portland cements.

(3) The addition of calcium chloride increased the strength of all the cements at all ages up to one year, beyond which tests were not made. Not only were the early strengths greatly increased by the addition of calcium chloride, but the one-year strengths were appreciably increased.

(4) The flow, or workability, of the concrete was increased by the addition of calcium chloride up to and including 3 per cent of commercial calcium chloride.

(5) Integral use of calcium chloride is effective in accelerating the curing of all cements, thus being of value in cold weather construction in decreasing the time necessary for protecting the concrete.

(6) The optimum amount of calcium chloride which should be used at the three curing temperatures was found to be:

(a) At 40 deg. F.—2 per cent of commercial chloride for all the cements.

(b) At 70 deg. F.—2 per cent of commercial chloride for the normal, or standard, portland cements and white portland cements, and 1.5 per cent for the high-early-strength cement.

(c) At 90 deg. F.—1.5 per cent of commercial calcium chloride for all the cements.

References

(1) Comparison of Selected Portland Cements in Mass Concrete Tests; by Robert T. Blank, Jour. Amer. Concrete Inst., Vol. 5, No. 1, p. 9, 1933.

(2) Effect of Composition of Portland Cement on Heat Evolved During Hardening; by Wood, Steinour and Starke, Ind. and Eng. Chem., Vol. 24, p. 1207, 1932.

(3) Early Strength Concrete—Effect of Temperature; H. F. Clemmer, Bull. 42, American Road Builders Assn., 1934.

(4) Calcium Chloride as an Admixture in Concrete; D. A. Abrams, Proc. Am. Society for Testing Materials, Vol. 24, Part II, p. 781, 1924.

(5) Digest of Available Information on Use of Calcium Chloride for Curing Concrete; H. S. Mattimore and H. H. Miller, Amer. Society for Testing Materials, Vol. 31, Part I, p. 347, 1931.

(6) Progress Report of Special Investigation of "Curing Concrete Pavement Slabs," F. C. Lang and Fred Burggraf, Proc. of the Ninth Annual Meeting of the Highway Research Board, Vol. 9, Part I, p. 369, December, 1929.

(7) The Heat of Hydration of Portland Cement Paste; Lerch and Bogue, Bureau of Standards Jour. of Research (RP 684), Vol. 12, p. 645, May, 1934.

M. H. Merrill has been appointed Western manager of the Robert W. Hunt Company at San Francisco. Since 1919, Mr. Merrill has been president of M. H. Merrill & Company, consulting engineers, and for the last three years has served as consulting engineer at San Francisco for Robert W. Hunt Company.

EDITORIAL

At the Speed of a Snail

Hearings have again been resumed on the proposed new building code for New York City, at sessions of the committee on buildings of the New York board of aldermen.

The greater part of the proposed new building code for our largest city was written in 1929, by groups of hard-working subcommittees of engineers, architects, contractors, material producers, and others, all of whom donated their services. The new document then produced is not merely a revision of the old building code—it is a completely rewritten code, in which provision is made for changes or additions to regulations of a purely technical or engineering character without going through the tedious process of legislative amendment.

It was the hope of the men who worked on these subcommittees that a modern code might be produced and adopted in New York City, and that it might then be offered to other cities as a model for general adoption. So rapidly was the work carried forward that, before the end of 1929, the general advisory code committee started to hold hearings for the purpose of reviewing the work of the subcommittees.

Here the various selfish interests—representatives of construction materials which long had held special advantages against competing materials because of antiquated provisions in the code—resorted to their usual obstructive tactics; and it was not until November 22, 1932—three years later—that the code was finally placed into the hands of the board of aldermen.

The aldermanic committee on buildings finally started to hold hearings on June 1, 1933, but these hearings were soon dropped, and nothing further was done until the recent announcement of the resumption of public hearings.

In Chicago a closely parallel situation has prevailed, in a similarly long-drawn-out effort to get a wholly obsolete code modernized. As in New York, selfish interests who have enjoyed practical monopolies are fighting to hold their advantage, and indifference of public officials does the rest.

In the meantime, we have the sorry spectacle of 1,500 city building codes and six or eight state-wide codes, all obsolete in greater or lesser degree, and each one differing from all the others.

Now the American Standards Association is organizing a new building code committee, to be charged with the task of trying to bring some kind of order out of our chaotic situation.

If suggestions are in order, our own suggestion is that the best service the A. S. A. can render is to join forces with the Merchants' Association of New York, and help this latter group in its hard fight to obtain adoption of the proposed new code for that city. With the New York code adopted in its present form, the construction industry will have something definite to work with—something specific to offer in the interest of modernity and uniformity in building regulations.

Last Session—Cement and Concrete

It seems to be a set policy of those who are responsible for the arrangement of the program of the American Society for Testing Materials to place the session on cement and concrete at the fag-end of the convention.

Year after year this arrangement prevails, and the 1935 convention, to be held in Detroit in the latter part of this month, is no exception. The session on cement and concrete is scheduled as the sixteenth (and the last), beginning at 8:00 P. M. of the last day of the five-day convention.

From experience with conventions in general, it is well known that by the evening of the last day of a long-drawn-out convention, the exodus of delegates and visitors is well under way. A limited number, interested in a special way in the particular subject under discussion, can be expected to remain.

Considering that cement and concrete are construction materials of major importance and almost universally employed in construction work, it does seem that this subject should not always be held back until the convention visitors have begun to scatter, and those who do remain are mentally tired out.

A system of rotation of subjects would correct this defect. It would bring new developments in cement and concrete to the attention of a greater number and a greater variety of visitors. It is not too early to consider the introduction of such a system of rotation in the convention of 1936.

Nelson Leads the Way

On another page in this issue is the story of the private enterprise of A. P. Nelson, concrete products manufacturer. He is building a modernistic home; and he is turning it over to the local chamber of commerce for a three months' exhibit, before moving into it. Here is a "lead" for the rest of the industry to follow.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Symposium on Building Materials

AT the annual meeting of the American Chemical Society, held in New York from April 22 to 26, one of the most interesting sessions was a symposium on materials of construction, comprising a list of 43 short papers and talks by architects, engineers, contractors, and manufacturers of building materials. Some of the subjects covered in this symposium were the following:

(1) Concrete in Modern Home Construction.

(2) Relationship of the Building Code to New Materials of Construction.

(3) Portland Cement as Revealed by High-Temperature Research upon Its Components.

(4) Portland Cement and Its Possibilities.

(5) The Plastic Flow of Portland Cement Concrete.

(6) Reactions of Calcium Chloride with Portland Cement Constituents.

(7) Waterproof Lime.

(8) Waterproof Masonry.

(9) Fiber Building Boards—Their Manufacture and Use.

(10) Plastics in the Building Trades.

(11) Building Insulations — Domestic and Industrial.

(12) Fire Loss Prevention.

FHA Motion Pictures Available

THE Federal Housing Administration has released a second reel of motion pictures which emphasize the advantages of the National Housing Act. The first reel, released several months ago, has been shown throughout the country.

Architects and concrete products manufacturers, in particular, and the home-building construction industry in general, will find it well worth while to get these motion picture films for meetings before local groups such as women's clubs and business men's organizations.

Hearings on New York Building Code

THE committee on buildings of the New York City board of aldermen has resumed hearings on the proposed new building code for that city—a document which has been in the hands of the board of aldermen since November 22, 1932.

Several hearings were held by the aldermanic committee on buildings during the early summer of 1933, but no definite action was taken.

Exterior Waterproofing of Masonry

A 27-page illustrated report by Daniel W. Kessler, issued as *Research Paper RP-771* and under the heading of *Experiments on Exterior Waterproofing Materials for Masonry*, has been published as a separate pamphlet by the National Bureau of Standards, Washington, D. C.

This investigation was concerned mainly with the effectiveness and durability of various types of waterproofings. Thirty-two samples of the more widely used commercial products and ten non-proprietary materials were studied. It is believed that practically all types were represented. Waterproofing effectiveness was rated by the ability of the treatments to reduce the absorption rate of masonry materials. Durability values were obtained by exposing treated specimens to the weather for various periods up to thirteen years. The preservative value of the treatments was studied incidentally.

Wax types were found to be the most durable, but showed the undesirable property of producing discolorations on most masonry materials. The insoluble soaps produced no appreciable discolorations but were not very durable. Fairly satisfactory durability was indicated for the thinned fatty oils and better lasting qualities were obtained for thinned fatty oils with a high melting point paraffin in solution. However, with such types it seems necessary to adapt the consistency of the treatments to the pore structure of the masonry. Treatments which produced a film on the surface, such as normal varnishes of thin consistency, lacquers, and wax emulsions, were not found to be very satisfactory. Treatments consisting of two reacting solutions which produce insoluble precipitates and also treatments which are intended to react with the masonry, were not found to be very effective.

Although the results of studies on preservative value were not sufficient in scope to be conclusive, some evidence was obtained that effective waterproofing materials retard the deterioration of masonry due to the more common weathering actions.

Copies of this report may be obtained, at 5 cents each, from the Superintendent of Documents, Government Printing Office, Washington, D. C. The report appears also in the March (1935) issue of the *Journal of Research* of the National Bureau of Standards.

Standard Samples of Cement

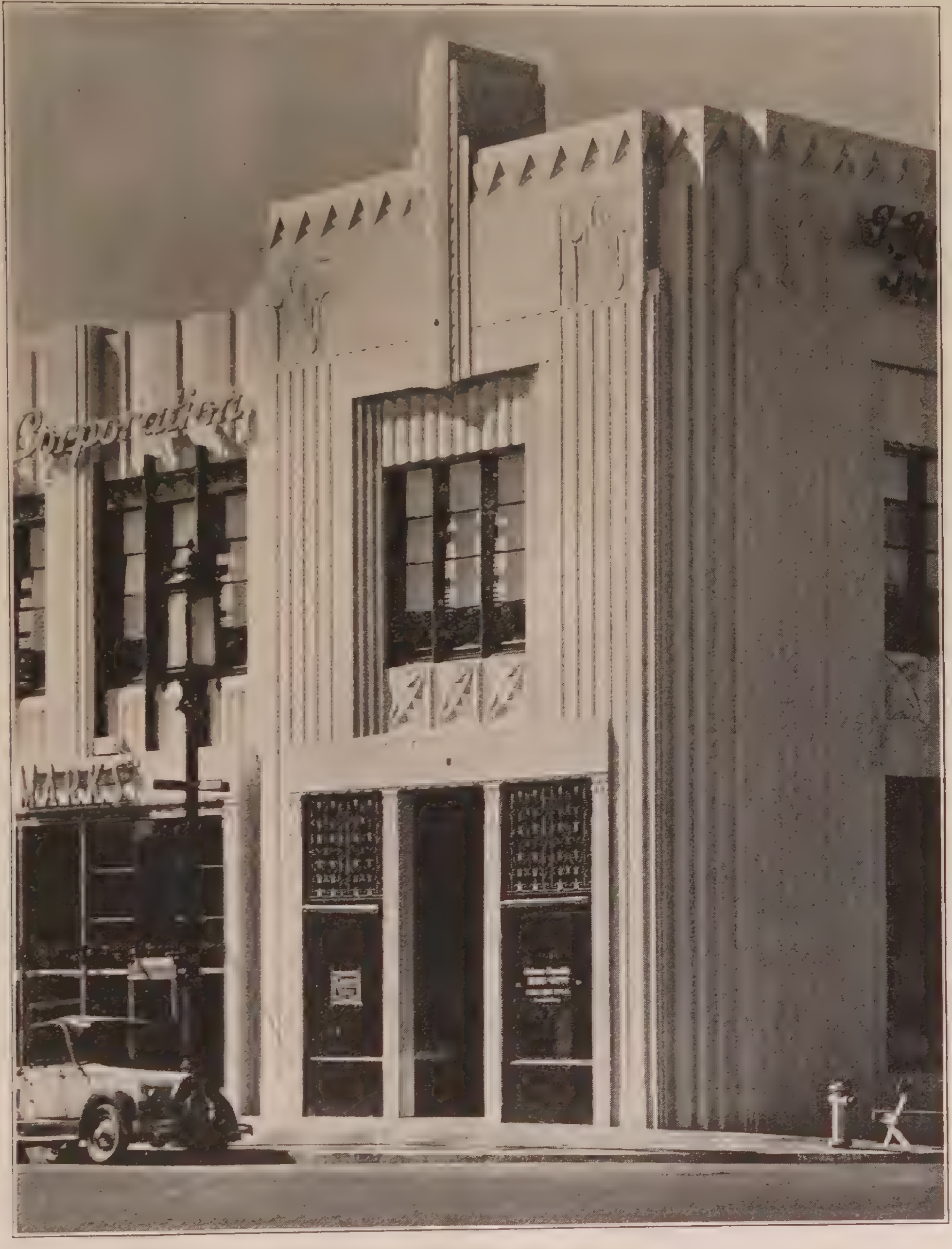
THE National Bureau of Standards, Washington, D. C., has issued a 12-page pamphlet under the heading of *Standard Samples Issued or in Preparation by the National Bureau of Standards*, containing information pertaining to the purchase and use of standard samples of cement and other materials. The pamphlet, which may be obtained from the Government Printing Office, Washington, D. C., is issued as a supplement to Bureau of Standards Circular C-398.

Index to German Standards

THE American Standards Association, 29 West 39th Street, New York, now has available the 1935 Index to all German Standards, DIN Normblatt-Verzeichnis 1935. The Index, consisting of 260 pages, is printed in the German language. The standards are listed alphabetically and by classification.

Copies may be obtained at $1.65 each from the American Standards Association.

Architectural Concrete



Walker & Eisen, *Architects*

This unusual example of architectural concrete in high-class business buildings is known as the Lion Building, in Los Angeles, at the northwest corner of Wilshire Blvd. and Catalina St. All ornamental panels and other decorative features were cast in place in waste molds that were set into position in frames built into the wall forms.

Corner molds and vertical fluting were formed with 2-in. material, planed on both faces and both edges, and sized. For the flat wall areas the form work was lined with fiber board. The architects were Walker & Eisen, of Los Angeles.

Simplified Concrete Mix Design

F. N. Menefee Shows How Graphical Methods Proposed by H. N. Walsh Are Based on Same Fundamental Principles as Fuller's Curves

In a recent issue of the "Journal" of the American Concrete Institute (Vol. 6, No. 1), F. N. Menefee, professor in the department of engineering mechanics, University of Michigan, discusses a previously published paper on "Simplified Concrete Mix Design," written by H. N. Walsh. Many of the points emphasized by Prof. Menefee are of interest to concrete technologists in general.—Editor.

A. C. I. *Proceedings*, Vol. 30, beginning on page 110, contains a paper by H. N. Walsh on "Simplified Concrete Mix Design" in which he has presented a graphical method for determining gradation of aggregate for producing dense, workable, strong concrete. Inasmuch as the presentation refers to the work of European engineers in developing grading curves in recent years and states that their researches form the basis for the method shown, the writer is taking the liberty of directing attention to part of what has been done by the American engineer in the same line, that readers may have the benefit of both methods.

Fuller's Tests

Fuller and Thompson made extensive researches on gradings of concrete aggregates mixed with and without cement, drawing many conclusions which are still considered sound. For instance, in referring to matrix with a large proportion of the largest size stone, Fuller says:

> Trial mixes of concrete made in the laboratory with uniform coarse stone gave greater density than could be obtained with uniformly graded stone. However, in the former, nearly 50 per cent of the weight of the total aggregate consisted of particles of the coarsest diameter of stone and in mixing . . . it was considered doubtful whether the concrete would *work* well in practice because of the apparent tendency of the mortar to run away from the stones, and leave pockets of stone and voids.

Fuller then points out that the uniformly graded material, although somewhat less dense, gave greater strengths, and assigned as a reason lesser homogeneity in the matrix where the large stone was of one particular grading. The author's experience seems to corroborate Fuller in this, for he says:

> For a fixed maximum particle size, one particular grading will give a greater weight per cu. ft. than any other, but the mixture so graded to give a maximum density will be harsh and difficult to place, especially if the biggest particles in it are more than one inch in diameter.

From Fuller's 21 conclusions, one may sum up the pertinent matter regarding density, strength, permeability, and workability of concrete by saying that if the mechanical analysis of the aggregate forms a parabola, whose equation is $P^2 = \dfrac{10{,}000}{D}d$

where P = percentage aggregate passing any given diameter or sieve opening d. (Ordinate on Fuller curve)
d = size of sieve opening (abscissa on Fuller curve),
D = size of largest particle,

that gradation of this particular material will, when mixed with a given amount of cement, be the densest consistent with workability and give the strongest concrete, provided, of course, other controlling influences are comparable. In this he differed from Feret, who for mortar at least advocated no medium sized sand grains.

Such a curve is shown in Fig. 1. By adding the cement to the aggregate that portion of the curve below 1/10 size of largest particle is raised to the percentage represented by the combined weight of sand and cement. Fuller advocated a modification of the parabola for cement, sand and gravel to an ellipse starting at 0 and running to an abscissa of 1/10 size largest particle and ordinate 37½ per cent passing, and a straight line from that point to size of largest particle, 100 per cent passing. Some advocate that 40 be substituted for 37½. This would mean adding more cement or more fines. By reference to Fig. 1, it will be noted that the parabola crosses the 1/10 size largest particle at about 31.6 passing, whereas Fuller's suggested ideal curve for cement and aggregate crosses at 37½ or 40 per cent. The dotted line in Fig. 1 is a plot of the author's 1:4 mixture. It will be noted that it represents a material with slightly less fines than Fuller's original parabola. Likewise, it represents a material with about the same amount of fines as are indicated by the dashed line curve which is a plot of sample 6, Table No.

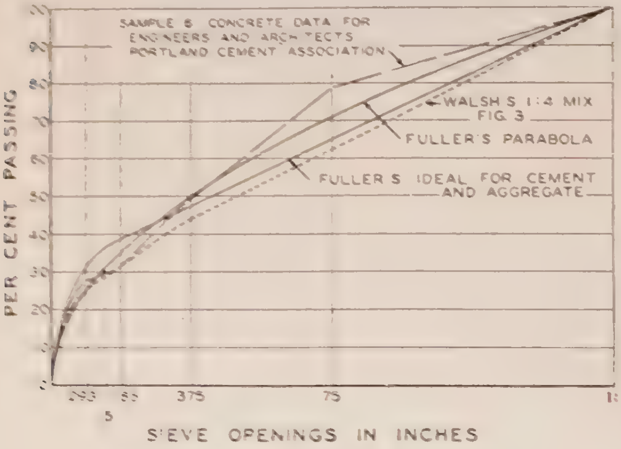


Figure 1

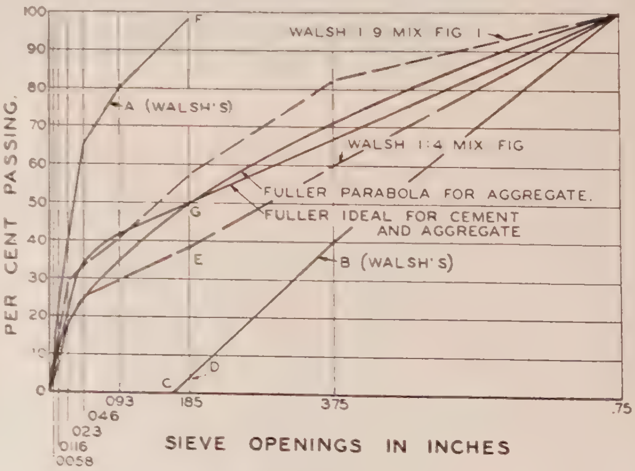


Figure 2

2 in "Concrete Data for Engineers and Architects," Portland Cement Association. Sample No. 6 had a fineness modulus (Abrams) of 5.75 and a strength of 3,540 p.s.i. Out of 19 other mixes, those, with fineness modulae lesser or greater than 5.75 all gave weaker concrete. In general, this corroborates the experience of the writer and seems to check with Fuller. For with the cement added, curve for sample 6 would rise to 40 per cent or more passing at sieve 0.15, thus approximating Fuller's ideal for cement and aggregate for that point, although it would be higher from there on. What has been said of sample No. 6 curve is applicable to Fuller's parabola and the author's 1:4 mix as far as their elevation at 1/10 size of largest particle is concerned. Particular attention is invited to Fuller's parabola and curve of sample 6, as an indication of the thoroughness and correctness of Fuller's work, for they each have practically the same fineness modulus; the parabola being the closest continuous curve to the broken curve giving the densest aggregate. The author's 1:5 and 1:6 mixes fall very close to Fuller's ideal curve and will have a better fineness modulus. Nineteen other gradations having lower fineness modulae and plotting above the Fuller ideal, and higher fineness modulae plotting below the Fuller ideal; all gave strengths less than 3,540 p.s.i. Hence, it is to be inferred that Abram's fineness modulus method where it plots somewhere near Fuller's parabola corroborates the Fuller graphical method.

In his discussion the author states that the proper proportions of sand and gravel for his 1:4 mix should be in the ratio of 36 lb. of sand and 64 lb. of gravel, but he does not say how he obtains that ratio. In Fig. 2, the writer has plotted the values of A and B of the author's sand and gravel on a Fuller type of chart. The Fuller ideal curve and the 1:4 and 1:9 curve of the author are also shown. Using the Fuller method to combine A and B to give the author's 1:4 curve, proceed as follows.

Take $\frac{DE}{DF}$ or $\frac{34}{94} = 36.2$ per cent of fines, or of material A. This leaves 63.8 per cent of coarse, or material B.

Considering the sample of combined material to be 10 lb., 3.62 lb. will be fine and 6.38 lb. will be coarse. Ninety-eight per cent of the fine material will pass the 0.185-in. sieve, or 3.54 lb. Four per cent of the coarse material will pass the 0.185-in. sieve or 0.254 lb. Thus of the combined 10-lb. sample of material, 3.54 + .254, or 3.794 lb., will pass the 0.185-in. sieve, which is the point E on the author's desired 1:4 curve. This process of plotting gradation of sands and gravels has been in use for many years and checks the author's figures exactly. By its use, any desired previously determined curve of materials can be obtained from any given fine and coarse materials. To combine the author's A and B materials to give a mixture which will plot very close to Fuller parabola, take

$\frac{DG}{DF} = \frac{46}{94}$ or 49 per cent, of fines.

In this case, a 10-lb. sample of the combination would have 4.9 lb. of fines and 5.1 lb. of coarse. Ninety-eight per cent of the 4.9 lb. will pass the 0.185-in. sieve, or 4.8 lb. Four per cent of the 5.1 lb. of coarse material, or 2 lb., will pass the 0.185-in. sieve. These two added together make 5 lb., or 50 per cent of the combined material which will pass the 0.185 sieve, and likewise is point G on Fuller's ideal curve. The writer believes that the combination of A and B materials which will follow the Fuller parabola will give a more workable mix and a stronger concrete than where the combination is made to follow the author's curve. By adding the ordinates above the author's curve and above Fuller's parabola, we obtain a fineness modulus for the author's recommended gradation of 610 and of the Fuller gradation of 573. At any rate, for a given amount of cement, it will be more workable, so it would seem that the fineness modulus (610) of the author's 1:4 mix is too great for the best possible strength and workability, or by comparing his curve with the Fuller parabola, it seems to fall too low on the chart, which is just another way of saying that it is coarser than should be deliberately designed. According to "Concrete Data for Engineers and Architects," this mixture would fall below 3,000 p.s.i., whereas with more fines or middle sizes to lift it on the chart, it would approach a possible 3,500 p.s.i. in 28 days.

The author states that his "type curves" do not involve the use of artificial gradings. Neither does the Fuller parabola, although it may be used to make artificial gradings if one wishes.

It appears that the author uses a No. 4 sieve as the dividing line between fine and coarse material. This is as good a division point as any, although the tendency in United States is toward calling anything sand which will pass the ¼-in. screen, provided there are fines in it enough to fulfill density requirements. Michigan state highway specifications require that 100 per cent of material submitted as sand shall pass a ⅜-in. circular hole sieve and that 90 per cent shall pass a ¼-in. sieve of the same type. Fuller made no such division, although his experiments were based on sands of various origins, most of which show maximum size to be about 0.2 in. He did place the break in his ideal curve at 0.1, the size of the largest particle, and in making combinations of fine and coarse material, many engineers combine so that the analysis curve of the combination passes through 00; 1/10 size largest particle, 37½ passing, and largest size particle, 100 per cent passing. However, it is best to make the combination so that the gradation curve of the combined material will pass through the intersection of the ideal curve and the abscissa representing the dividing line between fine and coarse material.

The writer has had the author's type curves for ¾-in. material checked, and finds that the upper curves in his figures give the densest mixtures, and that his lower curves can be brought up to the highest curve in each case by adding fines of proper proportion to the whole sample. For instance his 1:9 and 1:4 curves are shown herewith (Fig. 2) on the Fuller type of chart. Assume anything below 0.093 to be sand and that to the material represented by this curve we are going to add 1/9 more sand. (This is the amount of cement that is added.) If the original sample was 9 lb., 40 per cent of it, or 3.6 lb., passed the 0.093 sieve. All of the new fine material, or 1 lb., will pass, so of the combination, 4.6 lb. out of 10 will pass, or 46 per cent. Thus the curve designated as 1:9 would be raised to 46 per cent at 0.093 in. size.

Now treat the 1:4 curve in the same way. Say we have 4 lb. in the sample of aggregate, 30 per cent of which passes the 0.093-in. sieve. Thirty per cent of 4 lb. = 1.2 lb. Now add 1 lb. of sand finer than 0.093 and we have 2.2 lb. of the combination that will pass the 0.093-in. sieve. Two and two-tenths lb. out of 5 = 44 per cent; or the lowest curve is raised to practically

(Continued on page 26)

Detroit Program, A.S.T.M.

All Branches of Engineering to Be Under Discussion at Thirty-Eighth Annual Meeting—Cement and Concrete in Final Session

In order to provide ample time for the presentation of the many technical reports and papers to be presented at the thirty-eighth annual meeting of the American Society for Testing Materials, to be held in the Book-Cadillac, Detroit, June 24 to 28, sixteen sessions are scheduled. During the five days of the annual meeting, the Society's third exhibit of testing apparatus and related equipment will be in progress. Latest developments in the testing and scientific instrument field will be on display and A. S. T. M. committees and research laboratories will also take part.

While Monday, June 24, will be devoted to meetings of many of the Society committees, the annual meeting opens formally at 10 o'clock Tuesday morning (June 25). The closing session on Friday evening includes papers and reports in the field of concrete. Papers discuss the chemistry and physics of concrete shrinkage, research on concrete, and determination of the modulus of elasticity and Poisson's ratio of concrete.

Following is a synopsis of papers and reports dealing specifically, for the most part, with cement and concrete, and products made from these materials:

Measurement of Particle Size Distribution by Optical Methods. R. N. Traxler and L. A. H. Baum, The Barber Asphalt Co.

Studies the various factors influencing the determination of particle size distribution by means of the Wagner turbidimeter and develops technique for the dispersion of the finely pulverized solids. Compares the results obtained on cement, trap rock, silica, limestone, and green, red and black slate powders with the turbidimeter, with the size distribution data given by an air analyzer of the type described by Roller. Concludes that a direct proportionality does not exist between surface area (concentration of suspension) and turbidity, and that turbidity is influenced by the particle size and optical properties of the dispersed solid.

The Relationship of Materials to the House of Today and Tomorrow.

The quest today is at once for a house that is better and that costs less to build. In the effort to reach this difficult objective, there is much careful scrutiny of the design of houses, of the materials available of which to construct them, and of the various possible methods of constructing them in the factory and on location. The program of this meeting is designed to give a general picture of problems and progress in this important field both here and abroad, and particularly from the materials side. The subject will be discussed in the following two addresses:

The Federal Housing Problem. Stewart McDonald, Assistant Administrator, Federal Housing Administration.

Role of Materials in Modern Housing. J. E. Burchard, Vice-President, Bemis Industries, Inc.

A Wear Test for Flooring Materials. J. R. Shank, Ohio State University.

Describes a method of testing wear properties of flooring materials using the Dorry apparatus for which cylindrical test cores are cut from the material with an ordinary drill press, substituting a piece of copper pipe, with a small amount of No. 50 grain carborundum and water as an abrasive, for the usual diamond drill. Presents results on sandstones, marbles, granites, limestones, travertines, etc., slates, cement products and ceramic products.

Report of Committee C-1 on Cement. P. H. Bates, Chairman.

Recommends adoption as standard, with revision, of the existing tentative specifications for high-early-strength portland cement. Reports activities of subcommittees on masonry cement, low-heat and blended cements, volume change and soundness, plasticity tests, and on plastic mortar tests for portland cement. Contains preliminary report of the working committee on methods of chemical analysis on a co-operative study of a quick method for determining magnesium in cement; including two procedures developed respectively by F. P. Diener and J. C. Redmond. Reports on fourth tour of inspection of the cement reference laboratory.

Report of Joint Committee on Concrete. A. E. Lindau, Chairman.

Progress report describing the work of the Joint Committee in preparing detailed revisions of its earlier report of 1924, on Standard Specifications for Concrete and Reinforced Concrete.

Report of Committee C-13 on Concrete Pipe. Asa E. Phillips, Chairman.

Presents new tentative specifications for concrete irrigation pipe. Recommends for adoption as standard, with revision, the tentative specifications for cement-concrete sewer pipe. Submits extensive revisions in the tentative specifications for reinforced concrete culvert pipe.

Report of Committee C-9 on Concrete and Concrete Aggregates. R. W. Crum, Chairman.

Presents new tentative methods of making compression tests of concrete, using portions of beams broken in flexure, method of determining voids in coarse aggregate, tests for soundness of coarse and of fine aggregates by use of sodium sulfate or magnesium sulfate, and test for determination of amount of material finer than No. 200 sieve in aggregates. Recommends adoption as standard of the tentative specifications for ready-mixed concrete, with revision. Presents revisions in tentative specifications for concrete aggregates and test for apparent specific gravity of coarse aggregates. Proposes tentative revision of standard method of test for sieve analysis of aggregates for concrete. Includes a statistical study of data on sand and gravel.

Papers appended:

"Digest of Literature on Methods of Determining Permeability of Concrete," by T. G. Mooney, American Cement Corp.

"Methods of Tests for Determining Volume Changes in Concrete," by R. E. Davis, University of California.

"Report on Methods to Assure Durability of Concrete," by R. S. Greenman, Consulting Concrete Engineer.

"Comparisons of Different Types of Specimens for Compressive Strength Tests of Mortars," by H. J. Gilkey, Iowa State College, and H. W. Leavitt, Maine Technology Experiment Station.

Chemistry and Physics of Concrete Shrinkage. R. W. Carlson, Massachusetts Institute of Technology.

Presents test data which indicate that the finer particles of aggregate in concrete are compressed to a high degree by the shrinkage of the paste, and that the larger pieces of aggregate can not be compressed materially by shrinkage. Shows that a mortar containing only very fine aggregate may shrink almost as much as pure cement paste, while the substitution of coarse aggregate causes a great reduction in shrinkage. Concludes that the paste in being unable to compress the larger piece of aggregate must develop minute cracks perpendicular to the surfaces of the aggregate and cites the reduction in modulus of elasticity due to drying as evidence that this condition obtains.

Research on Concrete Disintegration. H. S. Mattimore and G. A. Rahn, Pennsylvania State Highway Dept.

Presents results of exposure tests on 45 concrete specimens 36 by 12 by 36 in. made from two different sands and two different cements, with different water contents. The specimens were exposed in northwestern Pennsylvania since the fall of 1930. They were buried 2 ft. in the ground, allowing 1 ft. of the concrete to be exposed. These specimens or small walls were constructed under laboratory supervision and had been under constant study since their erection in the fall of 1930.

Exhibit of Apparatus and Equipment

In addition to displays by leading companies in the testing instrument and related apparatus fields, the A. S. T. M. Exhibit will include non-commercial apparatus sponsored by A. S. T. M. committees or research laboratories for the carrying out of special tests and research work.

In the booths of the companies producing and distributing instruments, laboratory supplies, etc., there will be items of interest to many engineering materials fields, including ferrous and non-ferrous metals, cementitious, ceramic, concrete and masonry materials, petroleum products, rubber products, paving materials, and others. Latest developments in research and testing apparatus will be shown by various companies.

The Concrete Products Manufacturer

Code Administration + + + News of the Industry

ANSWERS to code questions that have been bothering manufacturers of concrete products will be found in this issue, on the next page.

The answers given are not to be regarded as official interpretations. They express, primarily, the personal opinion of the secretary of the code authority; and while he is in a favorable position to formulate his opinions —as expressed in his answers—he does not pretend to be a mind reader. In a word, he has no way of knowing positively that official interpretations from Washington would fully agree with his opinions.

CONCRETE is indebted to Mr. Bush for supplying the industry with these answers to typical questions. Individual products manufacturers can show their appreciation in the most constructive way by writing letters to us (or to Mr. Bush) and telling us their troubles. Or, if local groups or individuals have succeeded in ironing out some local difficulty, a letter reporting the essential facts would be extremely interesting.

From the Code Authority

Official Communications + +

Monthly News Letter

By **H. W. BUSH**

Secretary-Treasurer, The Code Authority, Concrete Masonry Industry[*]

NUMEROUS letters have reached this office purporting to show that members of the industry are in violation of this industry's code. It is surprising that in practically every case, Code Authority had no record of the plant complained about as being a member of the industry. Doubtless there are many members of the industry with whom we are not familiar. It will be of considerable help to Code Authority if members of the industry will forward the names and addresses of their competitors to the Secretary's office in order that we may check our lists and make the necessary additions.

We wish to advise the members of the industry that failure to comply with all of the provisions of the code is a serious affair. It not only works considerable annoyance and hardship on the individual member, but causes in some instances irreparable damage to the entire industry.

A recent case from our records will prove quite conclusively that co-operative action is required from the members of the industry in order to avoid serious complications. The Concrete Masonry Units Company (name being fictitious) was the low bidder on 20,000 concrete units. With almost unbelievable speed, the Secretary was advised and ascertained that the low bidder was in violation of the code. Immediate action was taken so that the awarding of the contract might be stayed until the violation was sustained. A week passed, action was not forthcoming as fast as we had anticipated, and the contractor was in need of material. Unable to delay the job further, he switched to ready-mixed concrete. Just one more proof that local code administration could have saved the order for the industry.

There is a point reached in code administration, the same as in other endeavors, where courtesy, kindness and co-operation cease to be virtues. May I give you a striking illustration of the damage that industry members can inflict upon themselves, whether knowingly or otherwise? Richard Roe (name fictitious), operating a products plant on Long Island, New York, has been adjudged in violation of this industry's code. The United States government has directed the Richard Roe Company to surrender all N.R.A. insignia in their possession to the postmaster, and has further informed them that they have no right to bid on jobs which are financed wholly or in part with federal funds.

This action in itself might not be so damaging to industry members who are unwilling to co-operate. By the terms and provisions of other codes, it becomes a violation of other codes for members of those industries to buy from or sell to any member of this industry who has been adjudged in violation of this industry's code. The building supply code prohibits distinctly members of their industry having any further business contacts with the Richard Roe Company, and we have accordingly advised the proper officials of the building supply code authority.

This is the first action of its kind that has been taken by your Code Authority, and it is hoped that the lesson may be so impressed on the minds of members of the industry that it will not be necessary to continue similar actions now contemplated. We believe that members of the industry should be encouraged and helped where any desire is expressed on their part to co-operate. We can not, however, tolerate further willful violations; and since the provisions of approved codes are federal law, protection will be given to the multitude of honest co-operators.

By the time this News Letter has gone to press, undoubtedly, the federal government will have taken action concerning the future of the Act. It is my personal opinion that the Act will be continued and that it will definitely include this industry. I believe that the majority of industry members, like myself, are of the firm conviction that codes can and will prevent demoralization, starvation wages, destructive price cutting, ruthless competition and ultimate bankruptcy, for at least this industry. We either can not or will not prevent it ourselves, without government supervision.

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[*] 211 Edgemont Place, Teaneck, N. J.

The need for a code for this industry is imperative, and the crisis is acute. The increased demand for this industry's products will of itself not eliminate the demoralizing influences that are eliminated by the provisions of our code. The necessity for continued and increased stabilization is, I believe, definitely recognized. If it is said by those members of the industry who are not entirely familiar with our accomplishments, that the code has not accomplished much, they must also concede that it has had to deal with a non-co-operative industry as a whole, that still believes in Santa Claus.

If men and industries such as ours are inefficient, they must be directed, encouraged and helped. We have profited by our mistakes and have found that considerable revision of our code is necessary. The present confusion in our national legislative bodies is causing, I know, a great many anxieties regarding the future of industry. After all, your code is merely a means to an end, and not an end in itself. Industry has always had a common meeting ground through the medium of associations; and as long as co-operative effort is recognized as the only logical means of survival, I am convinced that such co-operative effort will carry the stamp of approval from the entire industry for the continuance of its code as a means to permanent and lasting progress. I can see, and I believe you can see, that the salvation of efficient, economical and equitable code administration can only be obtained through local group administration with adequate funds, so that the provisions of the code can be properly administered and rigidly enforced.

Questions and Answers

Editor, CONCRETE: I was very much impressed with your May issue, and believing that it may be of advantage to the members of the industry, I am noting below a number of questions that have been asked of this office concerning the sales of industry products. It is to be understood distinctly, of course, that the answers to all of the questions represent the personal opinion of the Executive Officer of Code Authority, and are not to be considered as official interpretations.

Question from Illinois: If I publish prices on my products at my plant, is it possible for me to make a quotation for a specific job at a specific designation without filing my prices for carting or other methods of delivery?

Answer: No. Every part of the transaction of sale must be published and filed, including credit terms, trade and cash discounts, schedules of freight and cartage charges. See Article VII, Section 3, of the Concrete Masonry Code.

Question from Pennsylvania: My company manufactures and sells concrete masonry units which come within the definition of the Code for the Concrete Masonry Industry. The building supply code authority has informed me that the sale of these products is covered by their code, and therefore they have jurisdiction over my business. Will you kindly advise me if this is correct?

Answer: The manufacture of products of the Concrete Masonry Industry, and sales by those who manufacture such products, are subject only to the Code of Fair Competition for the Concrete Masonry Industry. Regardless of any claims of the building supply code or its code authority, they have no jurisdiction over the members of this industry, concerning the manufacture of industry products and sales by those who manufacture them.

Question from Washington: The Blank Building Supply Company (fictitious name) has demanded a list of my filed prices. Am I required to furnish them with this information?

Answer: Yes. Price lists or copies thereof must be made available during all business days for the inspection of all interested parties. See Article VII, Section 3.

Question from New Jersey: We are required in bidding on state work to quote a lump sum figure for concrete masonry units. I realize that this is not permissible in accordance with Article VII, Section 1(L). What is the proper method of complying with the state's requirements as well as the code for this industry? Is it permissible to quote on a square foot basis of a given wall area? I receive numerous requests for this type of quotation.

Answer: I am sure that the state purchasing agent will have no objection to your supplementing a lump sum bid with the unit prices at which the lump sum bid was figured in accordance with your filed prices. It is permissible to quote on a square foot basis on a given wall area, provided the square foot price is proportionate to the unit price basis as published and filed by you.

Question from Minnesota: In publishing prices to a contractor or consumer, must I indicate any allowances, discounts or commissions that a dealer would receive?

Answer: No.

Question from Indiana: We have filed with you a comparatively low price in order to meet certain competition. We are, however, obtaining higher prices for our material whenever possible. Is this a violation of the Code?

Answer: The original purpose of the provision relating to filed prices, as intended by those who drafted the Code, was to prevent unfair competition resulting from selling below published and filed prices. It was not the purpose of the provision to prohibit a manufacturer from obtaining a price in excess of his published price. Recently this question has caused considerable controversy among the members of our industry in certain sections of the country, and it was necessary for us to obtain an official interpretation.

The policy of open pricing requires published and filed prices to be considered as both minimum and maximum; and it was, therefore, necessary for the Administration to rule that members of the industry may not offer their products at a higher price than the prices that are published and filed. Prices may be revised, however, in accordance with Article VII, Section 3.

Question from Michigan: May we bid 15 per cent under our filed prices on government work such as slum clearances, subsistence homesteads, War Department work, etc., without further filing?

Answer: A modification of Executive Order No. 6646, of May 14, 1934, was issued by the President on June 29, 1934, and is known as Executive Order No. 6767. By this order it is possible for members of the industry to quote a price or prices not more than 15 per cent below their price or prices filed in accordance with the requirements of the Code. If advantage is taken of any portion of the 15 per cent discount, it is necessary that the bidder quoting a price below his filed price, by reason of any portion of the allowable discount, immediately file, after the bids are open, a copy of his bid with Code Authority. It is to be understood, of course, that this allowable discount of 15 per cent applies only on bids submitted to any agency or instrumentality of the United States government, or any state, municipal or other public authority.

I wish to make it clear that the phrase "agency or instrumentality" includes only that part of the state, federal or municipal governments that are engaged strictly in government functions, such as state road departments, departments of commerce, county boards of education, municipal fire departments, etc. It does not include sales to contractors or sub-contractors, even though they may be doing work for an agency or instrumentality of any public authority. If you are bidding direct to a contractor or sub-contractor on a government job, it is not permissible to deviate from your filed prices by taking advantage of any portion of the 15 per cent discount. It is to be understood, of course, that in direct sales to a government job, such as a sale direct to the War Department, where no contractor is involved, any portion of the 15 per cent may be deducted. This does not in any manner affect your prices filed with this office.

Question from Massachusetts: I have proof that my competitor is selling below my filed prices. If I meet this competition, I will be selling below my cost. Is this permissible in view of the Code provisions?

Answer: Upon due proof that any member of the industry is selling below your filed prices, you may immediately meet that competition, even though you are selling below your own individual cost. Code Authority, however, must be notified immediately.

211 Edgemont Place
Teaneck, N. J.

H. W. BUSH,
Secretary-Treasurer,
The Code Authority,
Concrete Masonry Industry.

The Clearing House

Letters and News Items

The Local Bootlegger

I have a competitor who is raising the mischief with my business. He is making concrete blocks in what used to be a tile factory, on property which he inherited from his father, and with old machinery which his father installed some years ago. He figures no costs except the cost of materials and his own time. Can you tell me what to do in a case of this kind?—T. J. S., Ohio.

[The first thing to do is to send this man's name and mailing address to the Secretary of the Code Authority, 211 Edgemont Place, Teaneck, N. J., and find out whether he has filed his prices with the secretary. You will probably find that he has not done so. Next, ask the Secretary of the Code Authority for the names and addresses of the nearest local administrative group. Then help this group to get itself organized, after which you can proceed along the lines suggested by Austin Crabbs in his letter to CONCRETE, printed on page 21 of the issue of May, 1935.—The Editor.]

New Concrete Tile Plant

THE LaMar Pipe & Tile Company, of Grand Rapids, Mich., has opened a branch plant at Reed City, Mich., in the old waterworks building. Machinery was installed in the latter part of April.

Concrete tile manufactured by this plant will be made with an almost dry cement mixture. The tile are soon removed from the form and cured in the building. Steam for the curing will be furnished from a boiler in a lean-to at the rear of the building. The tile are removed to the outdoors about half a day after being made and are further cured by steam, the tile being placed under large canvas tarpaulins.

J. W. Corson is superintendent of the plant at Reed City.

Wisconsin Plant Reopens

The Prairie Concrete Products Company of Prairie du Chien, Wisconsin, closed since 1931, has reopened to manufacture silo staves, tile and concrete brick. Clarence W. Steiner is in charge of operations.

R. Munson is president; Fred Pohlman, vice-president; Emmanuel Rod, secretary; Fred Grelle and George Griesbach, directors.

Concrete Barn in Kansas

The apparatus for making the concrete board for the walls of the new county barn was brought up from Wichita recently, and has been loaned to Pawnee county by a Wichita firm.

The concrete board is molded into slabs, and these are fastened together with rods, making the wall. The county barn is being built on the Santa Fe Trail in the east ledge of Larned.—*Larned (Kans.) Chromoscope.*

Springfield to Economize with Concrete Pipe

Tests of concrete pipe for sanitary sewers were made at the Highway Steel and Manufacturing Company plant recently with members of the city council and some citizens present. The council has agreed to receive alternate bids on concrete pipe instead of taking only bids on clay pipe as in the past.

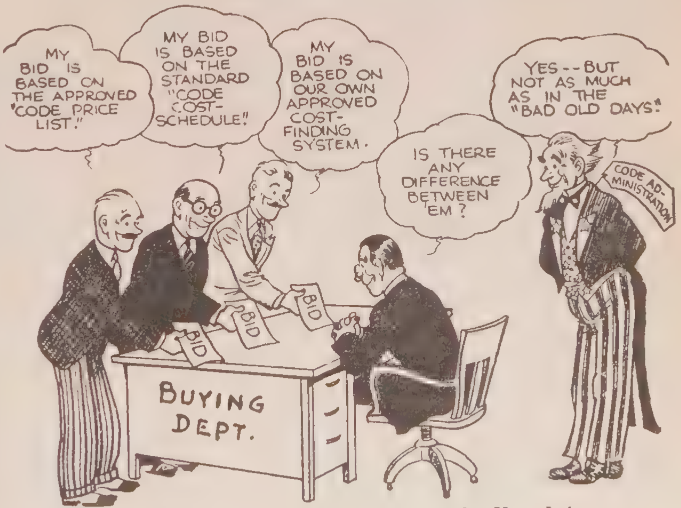
City Engineer John F. Hendrickson submitted a report on probable costs of the two types on the southeast flood relief main. It showed that the concrete pipe would cost $23,082.07 and the vitrified clay pipe would cost $29,929.39.—*Springfield (Mo.) News.*

New Pipe Manufacturer

The Cincinnati Concrete Pipe Co. has been incorporated with a capital stock of $100,000, with offices in Reading, Ohio, to manufacture and distribute concrete pipe.

Arthur S. Longenderfer is president; Sherman Johnson, Vice-president and treasurer.

Better Than the "Bad Old Days"


MY BID IS BASED ON THE APPROVED "CODE PRICE LIST."
MY BID IS BASED ON THE STANDARD "CODE COST-SCHEDULE."
MY BID IS BASED ON OUR OWN APPROVED COST-FINDING SYSTEM.
IS THERE ANY DIFFERENCE BETWEEN 'EM?
YES--BUT NOT AS MUCH AS IN THE "BAD OLD DAYS."
CODE ADMINISTRATION
BID
BID
BID
BUYING DEPT.

From *The New Informant.*

Products Man Builds House of Tomorrow

A. P. Nelson, Spencer, Iowa, to Reproduce Modernistic Century of Progress Home—to Be Exhibited for Three Months

A. P. NELSON, a progressive manufacturer of concrete products in Spencer, Iowa, has taken a most commendable and aggressive step in his decision to build a model house of concrete, steel and glass, in which will be embodied the modern designs featured in "The House of Tomorrow" at Chicago's Century of Progress Exposition.

Place Home on Exhibition

It is expected that the house, located on a corner lot with 75 ft. of frontage, at the intersection of two state highways, will be completed by July 4, after which it will be given over to the Spencer Chamber of Commerce for a period of three months, for public inspection. During this inspection period, other business firms of the city will cooperate with the view of displaying the most modern ideas in home furnishing, decorating, lighting, plumbing, heating and air-conditioning.

Concrete Walls and Floors

Plans for the building, conforming to the accompanying drawings, were prepared by Oren Thomas, a Des Moines architect. Walls and partitions will be of concrete building units produced at Mr. Nelson's plant, the Spencer Cement Block Works. Floors will be of concrete, covered with linoleums or carpeting.

In addition to the rooms shown on the plan of the ground floor, a stairway leads from the entry to the two roof towers. One of these towers opens to a flat roof section that will be occupied by modern porch furniture and sun shades. A fireplace is the main feature of the other tower, which, during the winter season, will serve as a storage room for the porch furniture.

Features of Plan

The semi-circular living room, with its huge fireplace, is the most modernistic feature of the ground floor. Observe also the corner windows in the bed rooms, and the fact that the dining room windows permit a view of the garden. The attached garage is entered from the rear. Complete air-conditioning equipment is being installed as a permanent feature of the building.

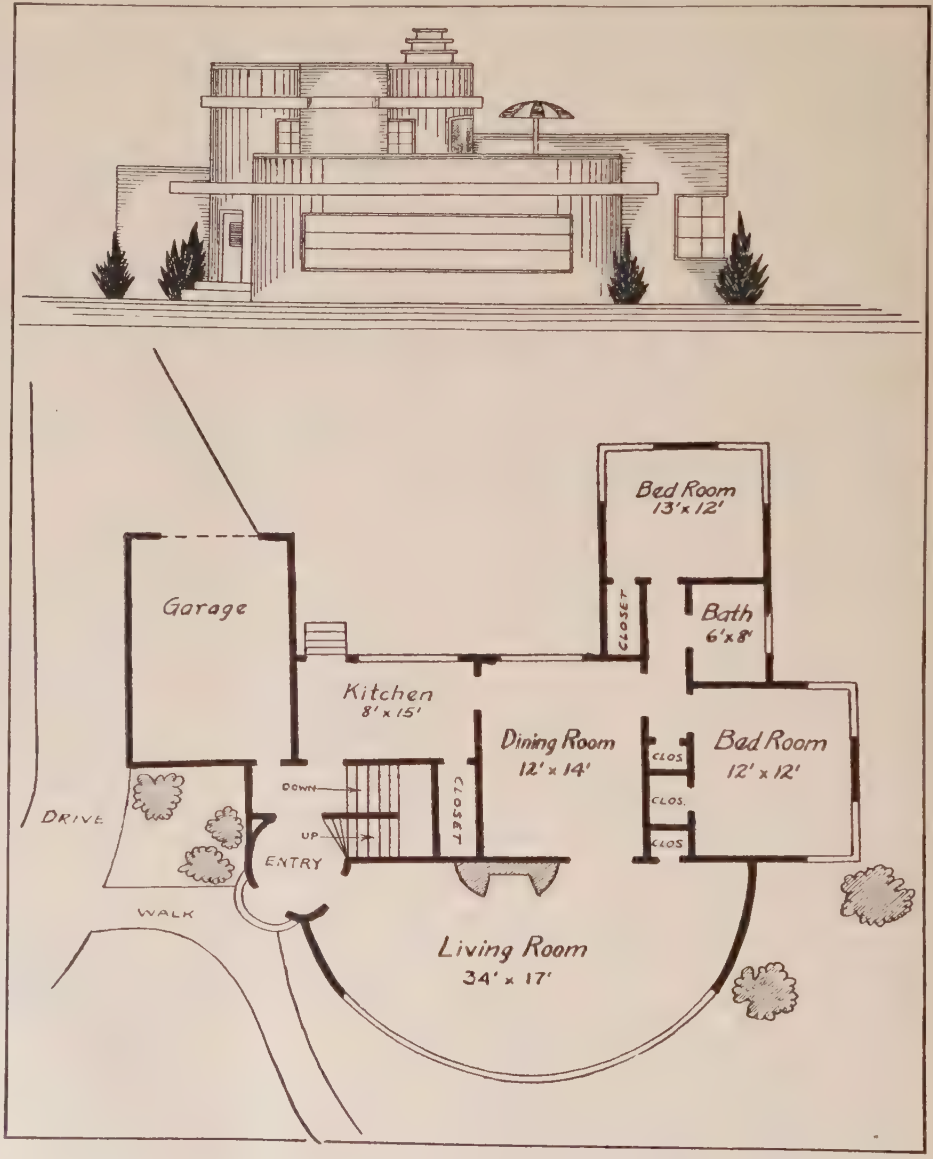
The architect's estimate of cost is approximately $5,000, including the air-conditioning equipment just mentioned, and all other permanent installations.

A Master Salesman

Mr. Nelson is building this modern "House of Tomorrow" for the occupancy of himself and his family; but aside from the unique character of the building itself, the arrangements made with the Spencer Chamber of Commerce for its use as a model exhibition home disclose that Mr. Nelson is blessed with a practical knowledge of the highest form of salesmanship. May his daring venture prove an inspiration to other products manufacturers.

It might be suggested also that much more might be accomplished in the construction of model homes in various parts of the country, through co-operation between associations of products manufacturers and home builders.

Acknowledgments: For the information contained in this article, and the plans here reproduced, CONCRETE is indebted to Mr. Nelson, and to Paul H. Martin, of the Spencer *News-Herald*. As previously noted, the architect is Oren Thomas, of Des Moines, Iowa.



Ground plan and front elevation of the Century of Progress "House of Tomorrow," being built by A. P. Nelson, products manufacturer, at Spencer, Iowa. Oren Thomas, architect

Designing Concrete Mixes for Pavements

By ROY W. CRUM
Director, Highway Research Board, Washington, D. C.

SO much has been written on this subject that it may be thought that the basic principles of concrete mix design are so well understood that further comment is superfluous. Nevertheless, recent reading of some articles on this subject has recalled to my mind that there are some phases of the subject that need further investigation.

With proper attention to the understood basic principles, mixtures can be devised for any specific conditions, within certain limitations. I say limitations, because the best practice recognized in this country requires the use of trial mixes, which to some extent refutes the postulate that the mixes are designed; for the word "design" does not usually connote subsequent trial and error methods.

Since the quality of concrete is principally dependent upon the relative amounts of cement and water in the mixture, the design of mixtures is largely a matter of deciding upon the water-cement ratio to use and the amount and grading of aggregates that will produce workable concrete most economically. Within proper limits for ratio of fine to coarse aggregate to avoid high shrinkage mixes, and on workability to prevent formation of honeycomb and stone pockets, the combination of the available materials for maximum economy can be arranged. But to decide upon the combination that will produce suitable workability requires trial mixes; and in the case of concrete for pavements, even trial mixes may be inaccurate because there is no known way of relating the workability of laboratory batches to the workability on the road under the placing conditions there prevailing.

Some recent progress has been made along this line by European engineers who have harked back to the use of grading curves such as were in vogue before the water-cement ratio principle was recognized. There is no question that typical curves can be established that are of value in arranging economical proportions with some measure of workability control. But still the problem of predetermining mixtures within the small range of workability allowable on a modern paving job has not been entirely solved.

An important point in specifying mixtures for pavement is that if proportions are arranged before the letting of the contract in such a way that bidders can be assured the cement required for the job will not vary from the estimate by more than about one per cent, substantial savings will accrue.

We should be able to find some way to use measured characteristics of the available cements and aggregates to devise mixtures that will yield properly workable concrete of the required quality, composed of definite quantities of water, cement and aggregate per unit of volume.

The chief stumbling block to the research work preparatory to working out such a method is the lack of a test for workability that will identify the consistency of a mixture that will work properly when placed on the road. When such a test becomes available, a first use of it that must be made is a study of the relation of the characteristics of aggregates to workability of concrete. Placement by vibration has recently introduced a new factor in the workability problem which must be studied in relation to proportioning.

For large organizations, familiar with their materials and fully equipped with laboratory facilities, trial methods are adequate and satisfactory; but there are many situations where some more definite design methods would be most welcome. — From Highway Research Abstracts, May, 1935.

A. A. E. Celebrates 20th Anniversary

Plans for Next Twenty-Year Period Outlined at Chicago Meeting

THE American Association of Engineers celebrated its 20th anniversary at a largely-attended dinner and entertainment program at the Brevoort Hotel on May 15, just 20 years after the adoption of the first constitution of the association.

An interesting sidelight of the celebration was the presence of four of the first eight members of the organization, and the further fact that the moving spirit in the arrangement of the dinner and program was A. H. Krom, member No. 1.

Notable among the events on the program was a presentation by H. A. Wagner, of national headquarters, in which the following activities were outlined as the association's goal for the coming 20-year period:

1. Complete classification of all engineering positions; specifications for every type of position; minimum salary schedule in every field.
2. A national clearing house for engineering positions; unified placement service with efficient regional offices. Close co-operation with industry and governmental agencies employing engineers.
3. Formulation of specific principles of good professional conduct, to be made official by all engineering organizations; covering engineers in private practice and employed men equally.
4. Legislative program, including uniform licensing laws; protection of the title, development of enforcement agencies in the profession comparable to those of the medical profession.
5. Recommendations in engineering training, including emphasis on vocational guidance, and incorporation of business courses in curriculum.
6. Comprehensive legal service.
7. Development of a recognized agency for handling public relations of the profession; publicity; and more aggressive participation by engineers in civic affairs.
8. Creation of a welfare foundation, financed by a large enough membership to cover unemployment insurance, accident insurance for all members, and annuities and pensions for retirement.

M. E. McIver is national secretary of the American Association of Engineers, at 8 So. Michigan Ave., Chicago.

Reinforced Concrete Aqueduct 241 Miles Long

Huge Construction Project in Southern California to Utilize 4,000,000 Cu. Yd. of Concrete

ONE of the most notable construction projects undertaken in many years, though given little notice outside the Pacific Coast states, is the huge 241-mile reinforced concrete aqueduct being built by the Metropolitan Water District of Southern California.

The 12-ft. horseshoe section here illustrated is 55 miles long and will require 1,230,000 cu. yd. of concrete. In addition, there will be 92 miles of tunnels, utilizing 1,560,000 cu. yd. of concrete; 65 miles of open channel requiring 470,000 cu. yd.; and 29 miles of siphons requiring 365,000 cu. yd. Parker Dam, located in the Colorado River near Parker, Ariz., about 100 miles downstream from Boulder Dam, will utilize 305,000 cu. yd. of concrete.

The entire southern California project will utilize 3,930,000 cu. yd. of concrete—more than was required even on Boulder Dam. Additional concrete is, of course, required in the construction of spillways, canal crossings, pump houses, and in the construction of Caljeco reservoir.

Member cities of the Metropolitan Water District of Southern California are Anaheim, Beverly Hills, Burbank, Compton, Fullerton, Glendale, Long Beach, Los Angeles, Pasadena, San Marino, Santa Ana, Santa Monica, and Torrance.

Horseshoe section of southern California aqueduct, showing section of base concreted and form work in place

From the Patent Office

By J. KAPLAN

Means for attaching furring strips to concrete building blocks: Jesse L. Crawford, Springfield, Ohio. U. S. Pat. 198,082.—The furring strip for a molded block consists of a metallic casing member; a wooden member enclosed therein; anchoring members initially driven through the wooden member and projecting from the rear side of the casing member. The anchoring device is adapted to be imbedded in the block, leaving the wooden member and the casing member entirely on the outside of the block. The outer face of the casing has prong-like projections.

●

Method of making cellular concrete: John A. Rice, Berkeley, Calif., U. S. Pat. 1,985,905.—The method of making cellular concrete consists in first preparing a slurry, then separately preparing a foam compound, then driving the foam compound into the slurry by agitation in opposite directions, and lastly permitting the mixture to harden in suitable molds—the foam compound containing casein, water, calcium hydrate, benzoic acid, beta naphthol and arsenious acid, or their equivalents in suitable proportions, substantially as set forth.

●

Hydraulic and similar cement: Karl Halback, Dusseldorf, Germany. U. S. Pat. 1,986,335.—The process of preparing a hydraulic cement—the ratio of the tensile to compressive strengths of which is approximately 1:6, and which forms a mortar which is not sensitive to shocks during setting—comprises the steps of hydrating ordinary portland cement or the like to a gel-like consistency while treating with carbon dioxide, then drying, grinding, and mixing with fresh untreated cement.

●

Cement for acid-proof brick work: E. Lux, Germany. U. S. Pat. 1,983,498.—Consists of a mixture of quartz, sand and quartz dust with talcum and water glass solution.

New Books and Pamphlets

Report of National Resources Board

REPORT OF NATIONAL RESOURCES BOARD. Published Dec. 1, 1934. Cloth binding, 455 pages, 9 by 11½ in., extensively illustrated with maps and charts.

This report, prepared by a Board of nine members under the chairmanship of Harold L. Ickes, Secretary of the Interior, constitutes the first attempt in our national history to make an inventory of our national assets, and the problems involved in bringing these assets into practical service. Methods are suggested for future co-operation among the various agencies of the Federal Government, for the purpose of insuring the proper conservation of our land, water and mineral resources.

Only a limited number of copies of the report has been printed; but while the supply lasts, copies may be obtained at $3.25 each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Concrete Handbook

CONCRETE HANDBOOK. Revised and enlarged edition, published by Popular Mechanics Press, 200 E. Ontario St., Chicago. Cloth binding, 110 pages, 6½ by 9¾ in., numerous illustrations. Price $1.00.

This book contains practical plans and details for using concrete in a great variety of ways around the home, the farm or the shop. It covers the smaller uses of concrete, and will be extremely helpful to the concrete contractor.

Test of Multiple-Span Arch

BULLETIN No. 269, "Laboratory Tests of Three-span Reinforced Concrete Arch Ribs on Slender Piers," by Wilbur M. Wilson and Ralph W. Kluge, has been issued by the engineering experiment station of the University of Illinois.

This is the first of two bulletins dealing with an investigation conducted by the station on multiple-span reinforced concrete arch structures. Bulletin No. 269 contains the report of laboratory tests of a single-span arch rib, and also of a structure consisting of a three-span series of arch ribs on slender piers. A later bulletin, to be issued shortly, will contain the report of similar laboratory tests of three-span reinforced concrete arch structures with spandrel columns and decks on slender piers.

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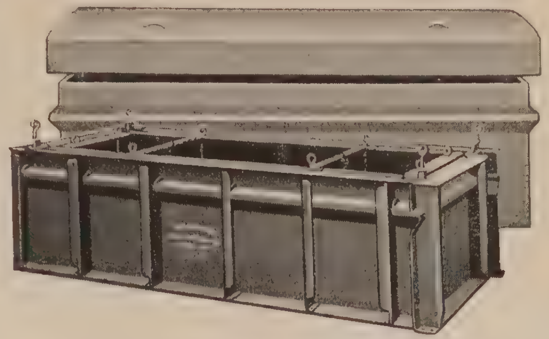

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Concrete Design

(Continued from page 17)

the same elevation as the upper when the upper material has 1/9 of its weight in fines added and the lower has ¼ of its weight in fines added. They will have the same fineness modulus and will both have the same density, and they will lie slightly above Fuller's ideal for cement and aggregate.

Reference to Fig. 2, upon which the author's type curves 1:4 and 1:9 are plotted, shows the Fuller parabola falling approximately one half way between them, and that by the addition of 10 per cent fines (sand or cement) to the material represented by his 1:4 type curve, it will be raised to almost exactly correspond to Fuller's ideal.

It is interesting to note that the matter of workability was recognized by Fuller, who, after determining the curves giving the greatest density and strength, said:

> It was found by experiment that more sand was required in the curves used in the beam mixtures than was indicated by the best ideal curves in the volumetric tests, for density . . . the first mixtures were made with curves corresponding to the best curves of the density tests. It was found necessary to raise them about 2 per cent at the tangent point to prevent a very rough surface on the beam.

In other words, as practically all investigators have found, there is a direct relationship between density and strength, but for practical reasons each must be sacrificed slightly to obtain the desired workability.

In conclusion:

1. Fuller's curves and those of the author are based on the same fundamental principles.

2. Abram's fineness modulus reduced the rate of acceptance of Fuller's curves, but was based on the same fundamental principles.

3. Although Fuller's curves are not universally used by American engineers and architects in designing mixtures, many do use them and get the same results as are shown by the author.

ORGANIZATIONS

American Association of Engineers, 8 S. Michigan Ave., Chicago, Ill.; M. E. McIver, Secretary.

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Chemical Society, Mills Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretarp, 7400 Second Blvd., Detroit, Mich.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Institute of Chemical Engineers, Bellevue Court Bldg., Philadelphia, Pa.

American Railway Engineering Association; E. H. Fritch, Secretary, 59 East Van Buren St., Chicago, Ill.

American Road Builders' Association; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-Ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 260 S. Broad St., Philadelphia, Pa.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Wm. F. Hurd, Secretary, Room 203, City Hall, Indianapolis, Ind.

Calcium Chloride Association, 4200 Penobscot Bldg., Detroit, Mich. R. A. Giddings, Secy.

Cast Stone Institute; C. G. Walker, Asst. Secy., 33 West Grand Ave., Chicago, Ill.

Cement Institute; H. C. Lundborg, General Manager, 11 East 44th St., New York City.

Concrete Reinforcing Steel Institute; R. W. Johnson, Secretary, 201 N. Wells St., Chicago, Ill.

Engineering Institute of Canada; R. J. Durley, Gen. Secy., 2050 Mansfield St., Montreal, Quebec.

Highway Research Board; Roy W. Crum, Director, 2101 Constitution Ave., Washington, D. C.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Cinder Concrete Products Association; Harry H. Longenecker, Secy., 1600 Arch St., Philadelphia, Pa.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Concrete Masonry Association; Horace W. Bush, Secretary and Treasurer, 211 Edgemont Place, Teaneck, N. J.

National Crushed Stone Association; J. R. Boyd, Secretary, 449 Munsey Bldg., Washington, D. C.

National Highway Users Conference; Roy F. Britton, Director, National Press Bldg., Washington, D. C.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Bldg., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, Earle Building, Washington, D. C.

National Terrazzo and Mosaic Association; J. M. Fuhrman, Secretary-Treasurer, 524 Brook Street, Louisville, Ky.

New Jersey State Concrete Products Association; Horace W. Bush, President, Lyndhurst, N. J.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary; Builders Bldg., 228 N. LaSalle St., Chicago, Ill.

Steel Joist Institute; R. W. Johnson, Secretary, 201 N. Wells St., Chicago.

Wire Reinforcement Institute; R. D. Bradbury, Director, National Press Bldg., Washington, D. C.

Wisconisn Concrete Products Manufacturers' Association, Inc.; L. E. Schwalbe, Secretary, Wauwatosa, Wis.

Ready-Mixed Concrete Group Holds Election

THE annual election of the seven regional representatives on the Code Authority for the Ready-Mixed Concrete Industry is being held in Washington, D. C., on May 31, at the office of the Code Authority, 951 Munsey Building.

Ballots, setting forth the candidates nominated for each region, were mailed to all known members of the industry with a transmitting letter announcing the date the election will be held.

Mixtures of Portland and Alumina Cements

IN a recent issue of *Revue des Materiaux de Construction* (pages 255 and 256, 1934), E. Rengade describes setting-time tests made with mixtures of Lafarge alumina cements and portland cements.

It was found that the mixtures produced a flash set in all cases except where the quantity of either cement was very small as compared with the other. In mixtures of 60 to 85 per cent of alumina cement added to portland, the flash set was most pronounced.

Coming Conventions

***June 11-14*—The Special Libraries Association. 27th Annual. Hotel Statler, Boston. W. N. Seaver, for the Science-Technology Group, Cambridge, Mass.**

***June 19-20*—National Lime Association. 17th Annual. Homestead Hotel, Hot Springs, Va. Norman C. Hough, Secy. and Mgr., 927 Fifteenth Street, Washington, D. C.**

***June 24-28* — American Society for Testing Materials. 38th Annual Meeting and Exhibit of Testing Apparatus and Related Equipment. Book-Cadillac Hotel, Detroit, Michigan. R. E. Hess, Asst. Secy., 260 South Broad Street, Philadelphia, Pa.**

***July 3-5*—American Society of Civil Engineers. Annual. Los Angeles, California.**

***Oct. 14-18*—National Safety Council. 24th Annual Safety Congress. Louisville, Kentucky. A. J. R. Curtis, 33 West Grand Avenue, Chicago, Secretary Cement Section.**

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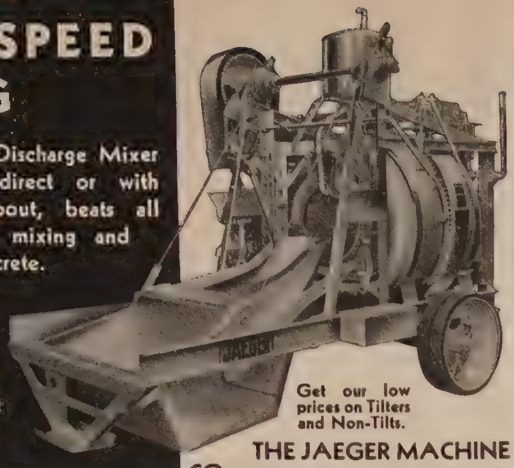

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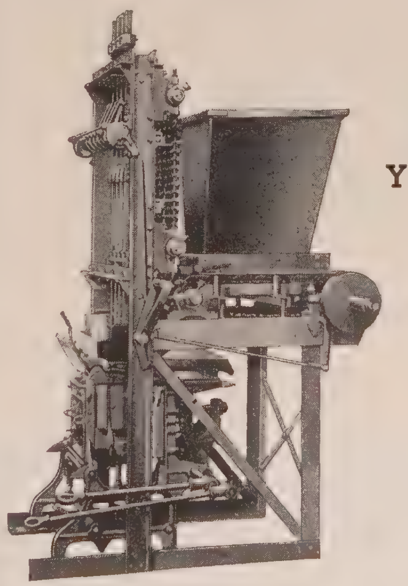

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Waterproofing a Swimming Pool

We have been called in on an outdoor swimming pool job here—a pool that was started and cast in the rough about ten years ago, but never finished. Arrangements have now been made to complete the work and put the pool into service.

The inside surface of the pool must be given some waterproof coating. Do you know of any finish that could be depended on for this purpose—something that will produce a surface that is easy to clean?—F. W. H., Florida.

A good material for this purpose is cement paint, which may be obtained either in white or any of the colors. A blue color below the water surface frequently is employed.

Cement paint is heavy, and when properly applied, the two coats will produce a very good waterproof coating. In applying cement paint, it is best to employ stucco men, rather than house painters. House painters are in the habit of brushing out paint in thin coats, whereas with portland cement paints the direct opposite should be done. The surface, of course, must be thoroughly cleaned before applying the paint.

A good solution for accomplishing this cleaning is a solution of zinc sulfate, consisting of 4 lb. of the sulfate dissolved in one gallon of clean water. This solution may be applied with a paint brush, a mop, or a squeegee, after the concrete has become thoroughly dry. Before applying the paint, the surface should be allowed to dry for at least 48 hours, and then brushed to remove the zinc sulfate crystals and dust. The surface of the concrete must then be moistened before the first paint coat is applied, and this paint coat should be wetted down as soon as possible after it has hardened sufficiently to prevent injury to the surface.

Before the second coat is applied, the first coat should again be dampened by spraying. The second paint coat should also be moistened with a fine spray as soon as it is hardened sufficiently to prevent the surface from being marred by the water. This spraying with water should then be kept up for several days.

One method of avoiding too rapid drying out of these paint coats is to apply them in the evening, giving them all night to become sufficiently hardened to permit spraying with water before the sun gets to work on them. Several spraying machines have been developed, especially for applying cement coats of this character. If the surface is sufficiently large, you may find it worth while to obtain such equipment.

Portland cement paints are produced by some of the cement manufacturing companies. In all cases, it is very important that the manufacturer's specifications be followed to the letter. While your local building material dealer may not have these paints in stock, they can be ordered through him.

Careful examination should be made of the joints in the floor and wall of this pool, for it is here that leakage is most likely to occur. Furthermore, if the floor of the pool has been exposed to the hot sun during these ten years, some cracks may have developed. These may need to be chipped out to the depth of an inch or so and filled with a joint filler. The regular joints may also require new filling material.

Sculptured Cast Stone

Please send me information on making and casting synthetic marble and stone. I am more particularly interested in the reproduction of sculptured models, in a substance that will be much harder than I am now using. I also want a material that can be tooled after casting.—W. E. M., Florida.

In making synthetic marble or other cast stone work, the first essential naturally is to use a crushed product of the type of marble or stone that is to be imitated. The proportions of cement, aggregate and mineral colors for some reproductions of natural stone are given on page 24 of the June (1934) issue of CONCRETE.

As a general thing, the proportion of one part of cement to three parts of crushed marble or stone answers the purpose very well, though it is always necessary to experiment with different proportions.

In connection with this work, you would find it extremely valuable to have in your possession a copy of H. L. Childe's book on "Manufacture and Uses of Concrete Products and Cast Stone." This 354-page volume may be obtained from our book department at a price of $3.00. Among other interesting material is a long chapter on surface treatment, containing a number of halftones and colored plates, and describing the processes involved in obtaining special facings as well as surfaces that can be tooled.

Concrete Manhole Block

I am considering adding concrete manhole and catch-basin block to my line of concrete products. Can you refer me to any standards of quality required for this product, and to processes best adapted to its manufacture?—P. O., Union, N. J.

The American Concrete Institute, 7400 Second Boulevard, Detroit, Mich., has issued a *Tentative Specification for Concrete Manhole and Catch-Basin Block* (Serial designation: P-1 C-27 T). In that specification the average ultimate compressive strength required is 1,500 lb. per sq. in., with no single sample falling below 1,200 lb. per sq. in.

You should ask the Portland Cement Association, 33 W. Grand Ave., Chicago, for a copy of their free booklet on *Concrete Block Manholes and Catch Basins.*

Regarding processes of manufacture, special molds are needed, of course; but otherwise, you should follow the same methods of manufacture and curing that are employed in the production of any high-grade concrete building units. Density of the concrete should be the principal objective—a quality best attained with high-frequency vibration.

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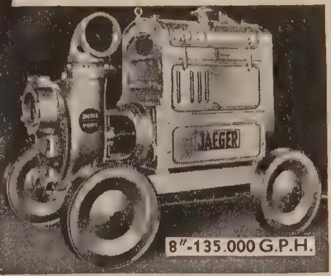

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A limited number of copies of the booklet, just made available, can again be offered to readers of "Concrete" while the supply lasts, at the reduced price of 50 cents a copy, which is half the publisher's price of $1.00.

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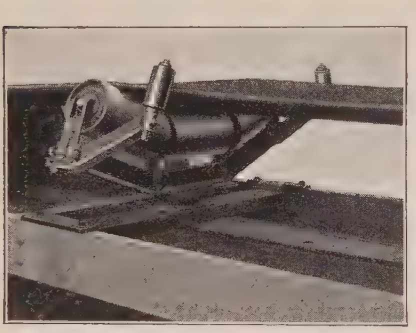
EQUIPMENT AND MATERIALS

HASKINS DM-5 machine has been especially designed for grinding and polishing marble, cut and cast stone. It is portable. Special drums and wheels have been developed to meet the individual requirements of stone and marble jobs. The most difficult to reach flute ends, dished and concave-shape column decorations, sharp corners and other hard-to-get-at places are quickly and easily honed and polished with this equipment and attachments, according to the R. G. Haskins Company, of Chicago, makers of portable grinding equipment for terrazzo, marble and cut and cast stone work.

●

LINK-BELT "Positive" self-aligning anti-friction idler for troughed conveyor belts, is announced by Link-Belt Company, Indianapolis, as a distinctly new and improved type of self-aligning idler which, they say, has been perfected in actual service.



Link-Belt self-aligning idlers

Conveyor belts should run practically central with their carrying or supporting idlers, to avoid possibility of injury to the belt edge in running against chutes, etc., if too much out of line. This condition may be automatically corrected by providing self-aligning idlers at intervals, to "train" the belt back automatically into a central position on the carrying idlers.

●

AUSTIN Surface Inspector and Form Checker is said to take the guesswork out of road surface finishing. The Austin Manufacturing Co., Chicago, claims accurate horizontal alignment of the side forms becomes a simple task with this instrument, that it checks the smoothness of newly-laid concrete (right after the free water has escaped) and automatically indicates any objectionable high or low areas. At this stage, concrete is still of a yielding consistency, and all such areas can be easily corrected by transverse brooming.

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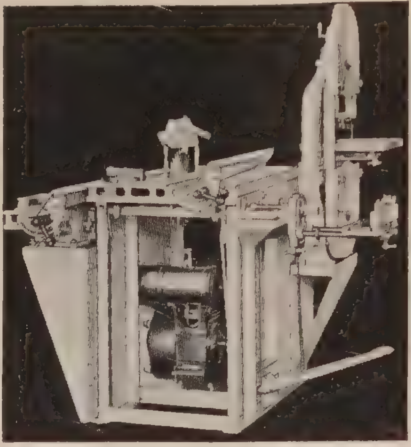


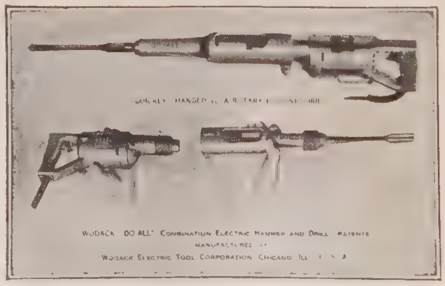
Home Builder Jr. with gasoline motor

●

SMITH Chemical & Color Co., of Brooklyn, New York, are now offering their improved and concentrated line of dry colors in all standard shades for use in concrete work, composition floors, roofing tile, stucco, cast stone, terrazzo and concrete brick. Working samples and technical information are available.

●

WODACK "Do-All" combination electric hammer and drill is a portable electric tool made by the Wodack Electric Tool Corporation, Chicago, that may be operated from any light socket. The tool may also be used as a portable grinder and buffer. When used as a hammer with star drills the tool drills holes in concrete and masonry up to 1⅜ in. diameter. By using special tools, it does chipping, chiseling, cutting and vibrating. The manufacturers say it is suitable for contractors, maintenance departments and installers of equipment using expansion bolts and similar concrete fastenings. A special attachment can be used for vibrating forms.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"Do-All" combination hammer and drill

Manufacturers' News

Robert W. Hunt Company, engineers, conducting a national and international engineering inspection, testing, and consultation service, with general offices in Chicago, has accepted the resignation of *C. B. Nolte*, their president, who has accepted the presidency of Crane Company.

James C. Ogden, formerly vice president, in charge of Robert W. Hunt Company's eastern and foreign activities at New York, will succeed Mr. Nolte as president.

Mr. Ogden will be assisted in the operation of the organization by F. M. Randlett, as vice president and general manager.

Robert W. Hunt Company was organized by Captain Robert W. Hunt and associates in 1888, and is an independent engineering inspection organization. Its clientele includes those identified with private and governmental transportation and construction work throughout the world.

●

R. G. Moeller Co., 14415 Meyers Road, Detroit, Mich., has been appointed distributor of Link-Belt crawler shovels, cranes, draglines, and locomotive track-type cranes.

Industrial Literature

ACCURATE Wire Cloth is the title of a new 4-page folder published by the Newark Wire Cloth Co., Newark, N. J., with exterior and interior views of their plant. There are illustrations and data on typical weaves and meshes, testing sieves, sieve shaker, metallic filter cloth, and strainers. There is also a condensed price list of testing sieves.

●

JACKSON high frequency concrete vibrators is the subject of a new circular, illustrating and describing the vibro-cast method of placing stronger, denser concrete in structures, highways, and products, according to the Electric Tamper & Equipment Co., Ludington, Michigan.

Vol. XLIII
No. 6

Cement Mill Section of
Concrete

JUNE
1935

Slurry Filter Economies in Wet-Process Plants

Not All Raw Materials Can Be Filtered Successfully—Definite Savings Realized Where Conditions Are Favorable—Summary of Advantages

THE important part that may be played by slurry filters in cement manufacturing operations may be visualized from a consideration of the quantity of water eliminated before the raw material enters the kiln. As an illustration, in a case where the moisture content of the slurry is reduced from 35 per cent to 19 per cent, the difference represents four-tenths of a ton of water per ton of clinker produced. Or, expressed in another way, it represents a difference of 150 lb. of water per barrel of clinker produced. The evaporation of 150 lb. of water requires about 100,000 B.t.u.'s of heat, so that the elimination of this quantity of water results in a marked reduction in fuel requirements. Assuming the heat value of coal at 12,500 B.t.u. per lb., this means a theoretical saving of no less than 8 lb. of coal per barrel of clinker produced.

Many Advantages Gained

One obvious effect of having the raw material enter the kiln at the lower moisture content of the filter cake (as compared with the moisture content of the slurry) is that it reaches the condition of complete dryness at an earlier stage; and, in consequence, the subsequent calcining and clinkering temperatures are reached at earlier stages. This is a distinct advantage in kilns of short and medium length, since it is clear that the burning is more complete.

A second important advantage is found in the fact that the filter cake, dried to a moisture content of around 18 or 19 per cent, has reached a consistency where it is no longer sticky. In consequence, the troublesome formation of mud rings—frequently experienced where unfiltered slurry is fed to the kilns—is avoided.

Not Practicable with Some Materials

Other advantages of slurry filtering are given in a summary at the end of this article. In the meantime, it must be made clear that not all raw materials are of a nature that permits the economical extraction of moisture from the slurry. For instance, many of the clays used by cement manufacturing plants in England are in a very finely divided, or colloidal, state. Others are partially of this character. The presence of this colloidal material has the effect of clogging the filter cloth, thus permitting only a partial removal of the excess water. Due to this situation, slurry filters have not been a success in England.

Raw materials containing organic matter, likewise, have a tendency to clog the filter cloth, thus slowing down the process and requiring a relatively large filtering area.

On this side of the Atlantic, no less than 21 of the 75 wet-process cement manufacturing plants in the United States, Canada, Cuba and Mexico, are equipped with slurry filters, the first of which was installed in 1925. Most of these 21 plants use either limestone and slag, or limestone and clay or shale, as their raw materials—from which it appears that the filtering methods developed up to the present time are well adapted to these types of raw materials.

Every Plant a Problem

Every plant, however, constitutes a separate problem in itself. Consequently, before a permanent plant installation is undertaken, a complete series of laboratory tests should be made to determine the kind and the area of filter that will supply the partly dewatered cake at the rate called for by the kiln production. Such tests may disclose the presence of colloidal

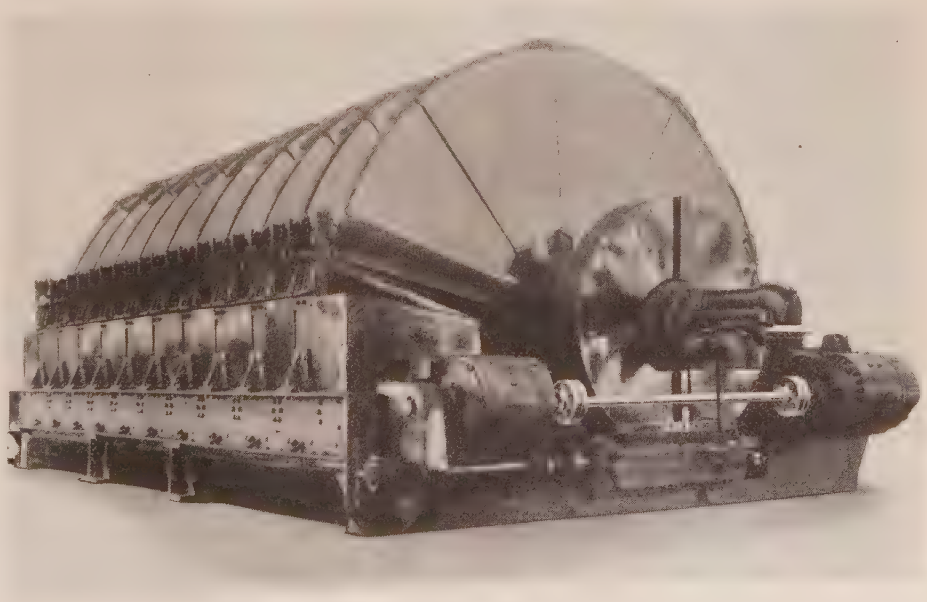

Fig. 1—Disc type of slurry filter provides a large filtering area

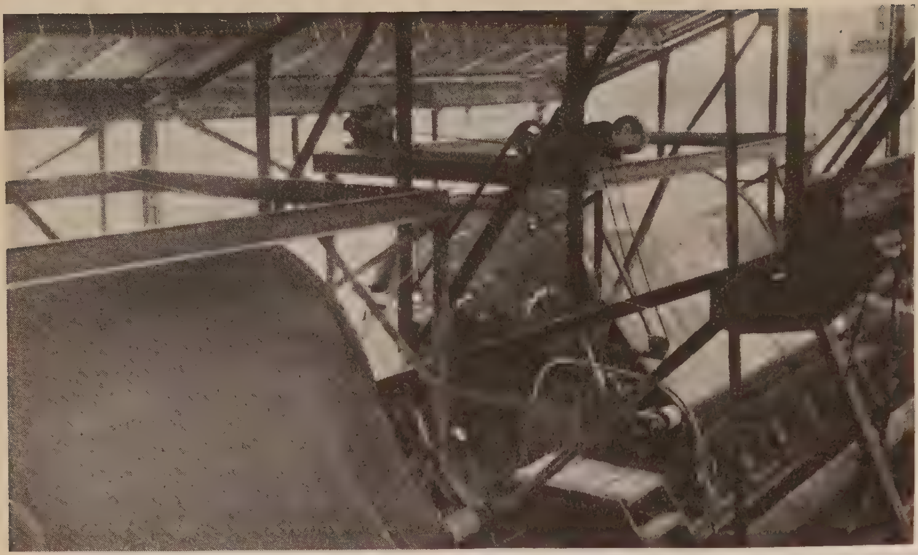

Fig. 2—Drum type of slurry filter installation in mid-western cement plant

materials or organic matter that, for reasons previously given, may make any known filtering process uneconomical. On the other hand, where a plant has a slurry that can be dewatered successfully, the economies realized are distinctly greater than the cost of installing and operating the filters.

Even after an installation is in operation, further test runs and adjustments must be made, to determine the speed of the filter and the thickness of the layer of slurry that will produce a filter cake of such moisture content that will prevent stickiness and thereby prevent balling up or formation of mud rings in the kiln.

Disc and Drum Types

The drum filter and the disc filter are the two general types of slurry filter thus far developed. In each type the filter is continuous and automatic in operation, the process consisting of a cycle of operations involving filtration, dewatering, and discharging, in succession.

In both types, also, the filters are operated under low air pressure, the pressure being limited to the difference between normal air pressure and that obtained in the partial vacuum created by the vacuum pump.

The Disc Filter

The disc type of filter consists of a succession of thin circular compartments, with filter cloth covering the sides of the discs (See Fig. 1). These compartments are supported on a hollow horizontal shaft which, in turn, is slowly rotated by a worm gear. Within this hollow shaft are the connections between the vacuum and the pressure pumps on the one hand, and the circular compartments on the other. Thus these circular compartments in the disc type of filter perform the same function that is performed by the segmental compartments on the circumference of the drum filter. That is, they supply the surface which at first is under vacuum, to hold and dewater a layer of slurry, then under pressure to remove the dewatered filter cake.

Cycle of Operation

In visualizing the cycle of operation, consider a sector of a disc just being submerged in the slurry in the tank that incloses the lower part of the slowly rotating filter. When the sector in question becomes completely submerged the full vacuum is applied to it. Because of the vacuum within. the cloth surface of the sector becomes coated with a layer of slurry which is held there while a portion of its content of water passes through the cloth and into the vacuum compartment. When the sector emerges from the slurry on the opposite side, it remains under vacuum through other mechanical connections until it reaches the position of discharge. In the meantime the coating of slurry has been drying rapidly, as the water continues to be drawn into the vacuum compartment within the disc sector.

As the rotation carries the sector beyond the position of discharge, low-pressure air is applied by the action of a pressure pump. This action inflates the circular disc, or bag, with air. As this inflated part of the disc moves down between the scraping edges of the filter-cake discharger, the cake is completely scraped off and drops to a belt conveyor which transports it to the kiln feed mechanism.

A Drum Filter Installation

A typical installation of the drum type of slurry filter is shown in Fig. 2. The illustration shows two of nine similar filters installed in a mid-western cement manufacturing plant to serve three rotary kilns. The filters, known as the drum type with string discharge, are 12 ft. long and 8 ft. in diameter, and the rotary kilns are each 160 ft. long and 10 ft. in diameter.

The filters are served by three single-stage vacuum pumps, 23 in. by 10 in. in size, each driven by a 40-hp. motor.

There is nothing complex about the cycle of operation. The level of the slurry in the tanks is maintained constant, by means of overflows. These tanks are semi-circular in section, and inclose nearly all of the lower half of the filter drums which they serve.

Filtering Cycle

Considering any one of the nine units in this installation, the filter-cloth surface of the drum rotates slowly through the slurry, gathering a layer of slurry over the cloth. This layer clings to the surface of the drum because of the partial vacuum within the drum—or, more specifically, within the compartments on the drum surface that are connected with the vacuum pump. These compartments occur over the entire circumference of the drum, and through them the vacuum operates. When a given compartment, or segment, is completely immersed in the slurry the vacuum is applied. When the segment emerges from the slurry, on the opposite side, the partial vacuum is maintained for a time, or until the connection with the vacuum is broken.

At first, after the segment under consideration emerges from the slurry, the layer of slurry adhering to it loses its moisture rapidly. The water in the layer is, of course, drawn through the filter cloth because of the vacuum within. This removal of water toward the inside of the drum continues at a decreasing rate until the vacuum connection is broken. This break occurs just before the dewatered filter cake is lifted from the surface of the filter cloth.

Lifting the Filter Cake

Lifting of the filter cake from the drum is accomplished by means of strings, spaced 1 in. apart and leading off tangentially from the surface of the drum. These strings pass around the discharge roll seen in the farther unit in the illustration (Fig. 2) at the lower edge of the sheet of filter cake. As the strings pass around the roll, the cake is discharged by dropping from the strings and onto a belt conveyor that passes along, just underneath and parallel to the discharge roll. The belt conveyor transports the filter cake to the kiln-feeding mechanism. The empty strings return from the discharge roll to the return roll, from which they return to the surface of the filter drum, preparatory to the start of another cycle of filtration.

Performance Record

The filters reduce the moisture content from 33 per cent in the slurry to 19 per cent in the filter cake, the consistency of the cake being just dry enough to prevent stickiness.

The fuel consumption was reduced by 15 per cent, and the production of the kilns was increased by 10 per cent. At the same time the more complete burning produces a cement of higher strength than was formerly obtained.

Summary of Advantages

The advantages offered through the installation of slurry filters, in wet-process plants where the raw material is of such a nature that the slurry can be filtered economically, may now be summarized, as follows:

(1) Because the filter cake is dried more quickly than the original slurry, the subsequent calcining and clinkering temperatures are reached at earlier stages. This results in more complete burning.

(2) Balling up and the formation of mud rings within the kiln are prevented.

(3) A definite reduction in fuel requirement is realized.

(4) The production capacity of the kiln is increased.

(5) The resulting clinker is usually found to be smaller and more uniform in size.

(6) Grinding conditions are improved, as a result of the improved clinker.

(7) The belt conveyor that transports the filter cake from the filters to the kiln-feeding mechanism provides a convenient means of returning (to the kilns) the dust collected from kiln housings, boilers or precipitators.

In the matter of cost, it is estimated that 1½ cents per barrel of clinker produced will, in most cases, cover the cost of operation. This figure includes the cost of cloth replacements, and the cost of operating labor, power and maintenance.

Cement Code Revised

Principal Changes and Deletions in New Document—Allocation of Output Discontinued

THE National Industrial Recovery Board, on May 13, approved a revised code for the cement industry. The revised code became effective May 21.

The code, approved originally on November 27, 1933, has been changed to eliminate the provisions for allocation of output, control of new plant construction or increases in capacity, customer classification, and prohibition of sales below cost as determined by a cost formula and a mandatory uniform accounting system.

Hours provisions have been revised to tighten restrictions upon overtime and to substitute a basic 40-hour, six-day week for the former provision permitting a 42-hour week or averaging of a 36-hour week for a period of more than six months. Standard labor provisions for the protection of employee welfare have been added. Minimum wage rates are unchanged.

The open price filing system has been revised to provide for filing with a confidential agent instead of with the Code Authority, and to conform to NRA practice in wording and procedure.

The revised code is the result of 52 changes of varying importance, made after public hearing on amendments proposed by the Code Authority, NRA and the Consumers' and Labor Advisory Boards.

In approving the revised code, the NIRB deleted the final article, which stated that members of the industry "assenting" to the code will not thereby assent to modifications.

The Board stayed Section 8 of Article X. This section would permit members of the industry to file with the Code Authority destination costs based upon land grant or other special freight rates applicable to shipments to the federal government.

Error in Flow Sheet in April Issue

An error appears in the flow sheet illustrated on page 39 of the April *Cement Mill Edition* of CONCRETE, in the article by Dr. Peter P. Budnikoff.

Near the bottom of the flow sheet are three adjoining rectangles, each marked 50 per cent. The one on the right should be 2 per cent. With this correction the flow sheet will show the mixture at this point to be 50 per cent of slag, 50 per cent of clinker, and 2 per cent of added gypsum.

American Institute of Chemical Engineers Meets at Wilmington

AGAIN the American Institute of Chemical Engineers has held a successful and interesting semi-annual meeting, and again all attendance records have been broken at the meeting held at Wilmington, Del., May 13 to 15. With a membership of approximately 1,300, programs, registration badges, and the like, were provided for 500. These were given out rapidly and many more were needed. When a technical organization can have a registration equal to 40 per cent of its membership in 1935, what can it expect in normal times?

The Institute is one of the best exponents of the application of science to industry. At its meetings and in its publications there are calculus, differential equations, thermodynamics (and other subjects recommended for light summer reading) to suit the most scientifically inclined, together with sufficient numbers of such items as tons per hour, B.t.u., and kilowatt hours, to make any engineer or operating man feel at home.

Of the many papers presented, the following may be given special mention:

The Place of the Pilot Plant in Process Development.
How We Use Our Semi-Works.
Heat Transmission by Radiation from Non-Luminous Gases.

Causes of Unsoundness of Cement

Review of the Literature—Conclusions Formed from Experience in Manufacturing Cements from a Variety of Materials, at a Number of Plants

By ALTON J. BLANK
General Superintendent and Supervising Chemist, Cementos Atoyac, S. A.
Puebla, Puebla, Mexico

THE soundness of cement is defined "as that property which resists any forces tending to cause disintegration or lack of permanency of structure."

When disintegration occurs it is usually accompanied by a change of volume in the cement, and since these changes may take place within a few days, or over a period of years, all methods of determining soundness must be taken into consideration, as must all of the causes that may effect soundness.

Perusal of the literature would suggest that there is more than one cause of unsoundness of cement, and a resumé of theories that have been advanced in this connection, together with individual and grouped investigations, must of necessity be given.

Where one group of investigators unreservedly accept one theory as the one and only cause of unsoundness of cement, other investigators are to be found who reject one theory in favor of several. Thus the unsoundness subject has been a most popular one with cement plant chemists, and scientists, and has probably been the basis for more research, and the subject of more written articles and discussions, than that of any other subject bearing upon cement manufacture and quality.

Many Investigations

Le Chatelier,[1] after a great series of investigations, concluded that free lime, and expansion resulting from it, was the chief cause of unsoundness. Lechartier[2] kept a number of concrete structures, in air and water, under observation for eight years, and noted that the initial expansion finally resulted in the complete destruction of the concrete. On learning that the original cement had 43.15 per cent CaO and 29.19 per cent MgO, he concluded that the high temperatures necessary in the calcination of the cement had sintered or dead-burned the free magnesia, with the result that its hydration was deferred until long after the hardening of the cement, with consequent expansion and finally disintegration of the mortar. Erdmenger[3] found that when cement contained considerable quantities of magnesia it would not withstand the continuous action of boiled water, and gradually became soft. Carey[4] considered it necessary to expose cement to air before use in order to hydrate any caustic lime present, and therefore avoid future expansion that would result from same. Le Chatelier,[5] after a series of tests, found that constancy of volume of a cement was always improved after the cement was kept in contact with air and slaked.

Erdmenger,[6] after further tests, concluded that magnesia could not replace lime as a constituent of cement without danger of unsoundness, and[7] after further experiments he concluded that the failure of cements to pass the "hot" tests was not due, as was sometimes supposed, to the presence of anhydrous calcium sulfate. The Newberry's[8] were also of the opinion that magnesia was incapable of replacing lime, and that in order to avoid unsoundness, composition calculations should be made on the basis of lime only. Le Chatelier,[9] after further experimentation, concluded that disintegration of cement was due to the deferred hydration of lime and magnesia, and the formation and crystallization of sulfo-aluminates which set up stresses. Campbell and White,[10] in their qualitative determinations, or identifications, of free lime in cement, generally associated unsoundness with free lime. Dyckerhoff[11] found an increase in magnesia to result in increased unsoundness in cement. Taylor[12] believed the most important factor in unsoundness to be an excess of free or uncombined lime. He also believed that an excess of magnesia, the alkalis, and the presence of sulfides were also sometimes responsible, while the presence of sulfate of lime might act in either direction, occasionally causing unsoundness, but generally tending to make sound an otherwise unsound cement. Riebling and Ries[13] found agreement between microscopic evidence of free lime and the results of soundness tests, to be very close.

Conclusions Differ

Klein and Phillips[14] in a study of the hydration of portland cement, concluded that (1) some cements would not pass the boiling test due to the fact that the free lime was sufficiently fine and high-burned so that in the boiling test it would hydrate, crystallize, and the growth of crystals would be sufficient to cause disintegration; (2) some cements would pass the boiling test but not the autoclave test, since the free lime was so coarse or highly burned as not to hydrate in the boiling test, but only in the autoclave, due to the high pressure and temperature employed; while (3) other cements will pass either test after seasoning where previously they would not, since aeration with insufficient water to allow solution and crystallization would cause the free lime to hydrate to the amorphous condition. Johnson[15] demonstrated by photographs of sections cut from concrete structures of long standing, that relatively large quantities of cement still remained unhydrated, and explained that the principal barriers to complete hydration are the surface tension of water and the neutral walls of calcium hydrate or carbonate crystals that prevent penetration of moisture. Witt[16] found soundness of cement was not affected by additions of calcium sulfate in amounts up to 10 per cent SO_3—the highest addition investigated. Bates[17] believes the amount of free lime necessary to produce expansion in portland cement depends on the ratio of expansive and cohesive forces.

Erdahl[18] believes that the general opinion among cement chemists that free lime causes unsoundness, is contrary to theory and to his observations, since the hydration of lime is rapid, violent and instantaneous. He believes mixing water, together with 24-hour storage of pats in a damp closet, is sufficient to hydrate any free lime present in cement. He concludes from tests shown that (1) free lime in the percentage it may occur in cement has no influence on soundness, and (2) that underburning, with the consequent formation of dicalcium silicate, is the real cause of unsoundness in cement. Campbell[19] studied the influence of the temperature of burning upon the rate of hydration of the magnesium oxide content and gave a series of curves showing why materials containing free magnesium oxide did not completely hydrate, even after 20 years immersion in water.

More Than One Cause?

Erdahl,[20] after making a series of experiments with addition of C.P. alkalis to sound cements, disproved ideas advanced to the effect that alkalis contributed to, or caused, unsoundness in portland cement. Bates[21] believes the curing of cements in bulk to be due to a decrease in the amount of expansive constituents (embedded uncombined lime) and a consequent increase of the cohesive constitutents ($3CaO.SiO_2$ and $2CaO.SiO_2$), and presupposes a chemical reaction, or hydration of this free lime taking place. Thus a decrease in the expansive constituents will necessarily increase the cohesive constituents. Meade[22] makes a humorous study of various theories advanced as to the cause of unsoundness in cement and opposes the dicalcium silicate theory of Erdahl[18] and rejects the Bates[21] theory of expansive and cohesive constituents of a cement, while himself offering no substitute for the free lime theory. Cadd[23] reports cement aging experiments similar to those of Erdahl[18] and agrees with the theory that unsoundness is caused by dicalcium silicates. Rankin[24] reports microscopic examinations of a grain of cement passing the 200-mesh screen show that it may consist of a perfectly sound shell free from cracks but inclosing one or more particles of free lime that may cause unsoundness. Erdahl,[25] from further tests, ridicules the Bates[21] theory of expansive and cohesive forces insofar as their part in the unsoundness of cement is concerned.

Smith,[26] after a number of experiments, and taking into consideration and weighing the results of investigators employing microscopic or petrographic methods, concludes that free lime is the cause of unsoundness in cement. Brown[27] believes that unsoundness does not exist and that findings along this line are due to incompetent tests. Catlett[28] deems it possible that there is more than one cause for unsoundness in cement, believing that at one time one influence may be acting, and at another time another, or that several may be working at the same time. He has found that some sound cements become unsound upon the addition of small amounts of potassium and sodium carbonate, contrary to Erdahl's[20] findings, and believes alkalis are contributing factors, more so with some cements than with others; also believes unsoundness due to delayed hydration and swelling of over-burnt lime which may be present, since lime burnt at high temperatures is slow in hydrating. Erdahl,[29] from further experiments, taking cements of unsound nature high in dicalcium silicate and burning at high temperature with an excess of lime, obtained a reaction forming tricalcium silicates and a sound product. He believes this experiment successfully proves that an unsound clinker may be made sound by reburning it at an exceedingly high temperature with an excess of lime, thus forming tricalcium silicate. He concludes that unsoundness is never caused by free lime, but by excessive amounts of dicalcium silicate present in the cement. Witt,[30] after a lengthy discussion, concludes that the causes of unsoundness are not at present fully understood, but believes the free lime theory to be far from letter perfect. On the other hand, he believes that some of Erdahl's arguments against the free lime theory are sound, while others are open to criticism; also that Erdahl's evidence in favor of the dicalcium silicate theory are far from convincing.

Molecular Constitution

Brown[31] discusses molecular constitution of cement and concludes with the view that, when calcium oxide enters the cement structure, it associates itself with dicalcium silicate and alumina as if it were a dioxide of lime, of which one atom of oxygen is displaced by the dicalcium silicate molecule. In other words, a calcium oxide ion can combine under the conditions imposed, with another calcium oxide ion, and these can combine with other ions of suitable affinity, the immediate result being a crystal substance designated as clinker. If, however, this lime fails to be ionized or combined, or if its ionized state can be rescinded, or reverted to ordinary lime, it becomes merely quick lime again and the countervailing associate, liberated from the atomic association, has no longer a wide molecular structure to preserve it from disintegration and dissolution. In fused slag there is a predominant molecular structure—in portland cement clinker there is an atomic structure in which, if the lime be properly ionized and proportioned, there is obtained a permanent substance. This ionization and the protection of its state depends on oxidation. The suspension of this state allows the forces of disruption, peculiar to quick lime, to come into play and cause the destruction of cement.

Myers[32] finds free lime injurious to the quality of cement; finds hydration of free lime in clinker by means of steam to result in a sound product. Emley and Bacon[33] found "popping" of lime plaster to be caused by slow hydration of those compounds that are formed between lime and certain impurities, such as in the case of cement clinker. Kuhl[34] denies the existence of free lime in cement and objects to the free lime theory of expansion for the reason that, during the setting of cement, a large amount of calcium oxide is set free through hydrolysis of the calcium silicates without producing expansion. He believes expansion in cement is due to increased crystal formation. Bates,[35] after experiments with varying amounts of magnesium oxide in cement, concludes that a content of 7.5 per cent magnesia is not too high to permit of a cement having satisfactory qualities.

Duration of Expansion

White[36] summarizes the expansion of neat cement bars—free lime causes an unusual expansion during the first few weeks in water, but its hydration should be finished in a year, and if the amount of free lime is small, volume changes beyond that time should be normal. Free lime hydrates slowly and causes slight additional expansion during the first three years in water; but if much magnesia is present, it causes marked expansion during the period from the third to the tenth year in water. Slow expansion persists for more than 25 years. There is danger with free magnesia in cement, even if all of the magnesia were present in the raw materials as silicate, since lime may prevent magnesia from combining during the burning process. The higher the lime the greater the tendency to liberate magnesia; and there is evidence that a cement with only 4.45 per cent total magnesia may have enough in the free form to cause undue expansion. Bogue[37] believes that any magnesia beyond that which can go into composition to form the compound $4CaO.2MgO.Al_2O_3.Fe_2O_3$ in the usual portland cement, appears as free magnesia; and that, contrary to White,[36] any increase in lime will have no effect on the amount of combined or uncombined magnesia. Hansen and Brownmiller[38] are more or less in agreement with Bogue[37] in respect to the question of how magnesia combines and why some may be present as free magnesia. Bateman[39] is of the opinion that unsoundness is most commonly due to the presence of free or loosely combined lime in cement. White[40] concludes that it has yet to be shown that Bogue's[37] calculated values for free magnesia apply to commercial portland cements. Feron[41] finds that with as little as 3.5 per cent magnesia present in a cement, as high as 180 m/m expansion is obtained, and concludes that magnesia is a factor in the unsoundness of cement. Dahlgren,[42] after a series of tests, decides that the main cause of unsoundness is the free lime present in cement. Pool[43] recognizes that the presence of any considerable amount of free lime in cement is objectionable, but that $Ca(OH)_2$ in the amount in which it would ordinarily occur in the average cement, would not be appreciably deleterious. Lerch,[44] after a lengthy series of experiments, concludes that pure compounds $3CaO.SiO_2$, $2CaO.SiO_2$, $3CaO.Al_2O_3$, $5CaO.3Al_2O_3$, $4CaO.Al_2O_3.Fe_2O_3$, and $2CaO.Fe_2O_3$, will all pass the steam test satisfactorily; abnormal expansion in certain cements is attributed solely to presence of free lime; cements with more than 3 per cent free lime are likely to be unsound; magnesia may be present in excess of 5.4 per cent and not cause unsoundness as measured by the steam test; alkalis do not cause unsoundness when present in such quantities as usually occur in portland cement.

Anderegg and Hubbell[45] conclude that the hydration of cement clinker is rapid at first and then falls off, and calculate from their tables that one cement clinker tested was 24 per cent hydrated within 24 hours, 42 per cent hydrated at 7 days, 51 per cent hydrated at 28 days, and 60 per cent hydrated at 3 months. Haegermann[46] finds cements with 2 per cent uncombined lime safely pass the steam test, while cements with 4 per cent uncombined lime pass the cold water test for soundness. Guttmann[47] agrees in general with Haegermann's[46] findings. Koyanagi[48] shows a number of tests where strength of cement is affected by sulfates, while soundness is not affected by either sulfates or sulfides. Anderegg,[49] working with experimental cements, finds that alumina content should be kept within reasonable limits, since sulfates reacting with calcium aluminate increases volume of aluminate up to about 200 per cent. Koyanagi[50] finds that when free lime content exceeds 2.2 per cent, cements are unsound in both the hot and cold water tests. Clair[51] concludes that presence of sulfate in materials used for concrete-making is objectionable where it exceeds 1 per cent by weight of the cement.

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Discuss Heat Transfer at Chemical Society

CHEMICAL engineering problems connected with heat transfer and with the transfer of material from one phase to another were discussed on the evening of May 10 by Professor Walter G. Whitman, of the Massachusetts Institute of Technology, at a joint meeting of the Society of Chemical Industry with the New York sections of the American Chemical Society, the Electrochemical Society and the Societe de Chimie Industrielle.

Prof. Whitman's paper was entitled "Diffusional Processes." The transfer of material and of heat from one phase to another is largely a problem of diffusion through films at the fluid boundaries. Recent work has demonstrated, however, that mixing by turbulence within the main body of fluid is seldom so complete that non-uniformities can be disregarded. He cited numerous examples of transfer problems which are dominant in practical operations. He showed that apparently diverse phenomena could be correlated by simple generalizations and emphasized the value of such correlations in the work of the chemist and chemical engineer.

Prof. Whitman was formerly associate director of research of the Standard Oil Company of Indiana. Last fall he was appointed head of the department of chemical engineering at the Massachusetts Institute of Technology. His outstanding scientific contributions have been in the fields of corrosion and the absorption of gases by liquids.

Hard-Surfaced Grinder Rings

Hard-surfaced grinder rings run about 6,000 hours in the operation of grinding hot clinker, as compared with about 450 hours for steel rings.

◆ EDITORIAL ◆

Economy of Slurry Filters

An installation designed to increase the capacity of rotary kilns by 15 per cent may arouse only mild interest while plants are operating at a low percentage of capacity; but when there is a corresponding unit saving of around eight pounds of coal per barrel of clinker produced, the situation presents a more attractive color.

Even in a small wet-process plant producing no more than a million barrels a year, this saving in coal would amount to around 4,000 tons annually; and assuming the cost of pulverized coal at $4.00 a ton, the gross saving would mount up to about $16,000 in a year's operations. And, eventually, the increased capacity of the kilns involved would also become an advantage worth having.

Economies of the scope here indicated may be accomplished through the installation of slurry filters in wet-process plants that utilize raw materials that lend themselves readily to the dewatering treatment. It is true that some types of raw material can not be dewatered economically with any of the slurry filters thus far developed; but when operating on slurry that can be filtered, these installations soon pay for themselves.

Here is another department in which the manufacturer may meet his rising costs by modernizing his equipment.

Utilizing a Waste Material

The mountains of air-cooled blast-furnace slag in the vicinity of Pittsburgh, Birmingham, and elsewhere, testify to the fact that industry has not yet found sufficient commercial uses for this waste product as fast as the steel mills produce it.

The cement industry has found several ways to utilize blast-furnace slag, but a few cement men have visualized a much greater expansion in this direction.

For many years some of the greatest manufacturing units in the American cement industry have used slag as one of their major raw materials in the production of standard portland cement. In this respect the industry has gone the full limit in the utilization of basic blast-furnace slag.

In other respects there is much room for growth—as, for instance, in the production of slag-portland cements of the types used in Europe for many years for sea-water construction and related purposes. The German iron-portland cements, for illustration, consist of a ground mixture of 70 per cent of portland cement clinker and 30 per cent of granulated slag, either water-cooled or dry-granulated. The British standard specification for slag-portland cement calls for the addition, to portland cement clinker, of not more than 65 per cent of granulated slag. While some cement manufacturing companies are equipped to produce this type of cement on special orders—and frequently do supply it—the truth remains that slag-portland cements have not as yet won general acceptance in the United States. In fact, many city building codes specifically prohibit their use in structural concrete work!

Slag cements, made by grinding mixtures of granulated blast-furnace slag with slaked lime, also have found only a very limited application thus far. It is only fair to the construction industry to add that this may be due to the frequent use of this product for purposes to which it is not suited. An article beginning on page 39 of the March (1934) issue of the Cement Mill Edition of CONCRETE throws much light on this subject—not only on advanced manufacturing processes, but on the types of construction work to which the finished product should be limited. Undoubtedly this type of cement would be improved if its manufacture were in the hands of the portland cement industry.

Finally, no secret is being made of the fact that some cement companies are looking into the possibilities of processing blast-furnace slag to produce lightweight aggregates for concrete. This seems to be a perfectly logical subsidiary activity for cement companies that have slag at their disposal.

The A. S. T. M. at Detroit

The program of the annual meeting of the American Society for Testing Materials, to be held in Detroit from June 24 to 28, touches the cement industry at many points.

Familiar subjects such as particle-size distribution and the report of Committee C-1 on Cement will be mingled with less familiar ones such as research on the disintegration of concrete and the chemistry and physics of shrinkage.

More easily-understood problems, including the federal housing campaign and discussions of construction materials for the house of today, also will form the subject-matter of convention papers.

Cement men can not afford to pass up the Detroit convention.

Natural and Artificial Pozzolanas

Pozzolanic Cements, Once Neglected, Regain Favor for Concrete Works in Sea Water—Search for Artificial Pozzolanas—How Material Is Activated

By MANUEL DE LOS SANTOS
Chemical Engineer, Cementos Rezola, S. A., San Sebastian, Spain*

WHEN the study of pozzolanas is undertaken, one encounters many false leads before arriving at the point of sorting out treatises and reviews, and confining his investigations to the information required to enable him to draw practical conclusions. Published reports of previous tests and investigations must be arranged into proper classification, with respect to the exactness of the knowledge to be obtained from them, and the adequacy of their application to these natural and artificial substances.

It is not our intention to dwell upon the possible advantages of the better pozzolanic cements as compared with other types, or vice versa, when coming into contact with aggressive liquids, more especially with sea water. We shall consider the problem beginning with the field of experimentation on pozzolanas in the laboratory; and in this connection we have always before us the information obtained from the works of Feret and Baire, in France; of Ferrari, in Italy; and of E. de Castro, in Spain, as the basis of our tests.

What Is Pozzolana?

It will be well, in the first place, to establish a nomenclature for pozzolanas and their substitutes; and first, it is proper to define pozzolanas and their properties.

What is a pozzolana? It is a natural substance of diverse origin, possessing hydraulic properties when mixed intimately with air-slaked lime.

What was its original purpose? To provide a strong mortar capable of setting and giving good service in submerged construction.

This is about all that was known about pozzolanas up to the time of the appearance of divers cements which culminated in the development of portland cement; and pozzolanic cement, when thus placed in competition with others, from which excellent results were obtained, lost favor to a considerable extent.

Interest Is Renewed

Soon, the destruction of concrete construction work in sea water again turned the attention of investigators toward the permanent mortars obtained with a pozzolanic base; and the study of the behavior of these other cements when subjected to the action of sea water indicated the presence of some chemical reactions which contributed to the disintegration of the mortars. And it was the liberated calcium hydrate in the concrete going into combination with the magnesium salts that appeared to contribute, in large part, to the destruction.

Then, if the mortars with a pozzolanic base remained intact, it must be because of an exclusive property or ingredient possessed by them, permitting it to go into combination with the liberated lime. Studies in laboratories confirmed this belief, and our knowledge concerning *pozzolanic activity* was developed.

What is the present purpose of pozzolana? To incorporate into portland cement this pozzolanic activity, or the power to absorb the liberated lime, by mixing the pozzolana intimately with the cement, so as to conserve within the mixture the physical strength of the portland cement without the disadvantages of the latter—namely, the dangers resulting from its use, alone, in sea water.

Search for Artificial Pozzolanas

Upon the discovery of this property in natural pozzolanas, search was made for similar properties in artificial products, thus giving rise to what is known as *artificial pozzolanas.*

And since the ingredients which govern the quality of these prepared artificial materials are peculiar—in many cases—to those of natural pozzolanas, this explained how the characteristics of natural pozzolanas could be accepted for prepared pozzolanas, without foreboding or equivocation. Perhaps it would be more profitable to search in these prepared pozzolanas for the chemical affinity with lime, omitting other tests, such as the determination of quality.

It does not appear that the physical strength of these pozzolanas or the artificial materials are a direct function of their pozzolanic activity—at least not immediately nor in any of the cases determined. We have seen substances especially prepared, which have decided power to absorb lime, but offer scarcely any resistance to crushing in the first few turns of the tube mill when being ground with hydrated lime. Thus was confirmed that which we shall later disclose in connection with the definite method of activating pozzolanas or analogous materials to produce a beneficial influence on maritime concrete structures.

It is proper, therefore, to mark clearly the scope of treatment of the artificial products; and in the nomenclature of cement there is provided a definite distinction between *pozzolanic cements,* obtained from natural pozzolanas, and *cements for use in sea water construction,* prepared from artificial products, or simply through variations from the normal proportions of raw materials for portland cement, or through the addition of blast-furnace slag to the clinker when grinding.

Method of Activating Pozzolana

A pozzolanic material acts on lime through its active elements, and these are principally silica and alumina.

Two explanations are offered to account for the activation of the elements just mentioned. The first presupposes a phenomenon of a chemical nature, and the second presupposes one of a physical character, although there is no lack of advocates of the theory that this activation is both of a chemical and a physical order. We believe it is more logical to suppose that the pozzolanas, according to their composition, are able to act chemically toward the formation of calcium silicates and calcium aluminates, more or less hydrated;[1] or to act physically, through capillary attraction such as lime experiences with a part of the active elements;[2] or through the formation of silica gel having the capacity to fix lime through capillary tension;[3] or through the simple crystallization of the basic materials and the formation of microscopic cavities in the porous material.[4] Among the latter adherents one encounters also Dr. Hans Kuhl, who, denying the chemical nature

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*Translated from *Cemento* (Barcelona), issue of February, 1935.

[1] Le Chatelier and O. Rebuffat.

[2] Michaelis.

[3] G. Gallo.

[4] Ferrari.

of pozzolana, believes that the indication of chemical action is derived from the hydration of the silica gel, which brings about a greater density of the concrete and impedes the entry or passing through of aggressive waters.

But all are in agreement that the lime, as such, disappears more or less rapidly, remaining neutralized in some cases in the form of chemical combinations, and in others simply blocked. In both cases it remains protected against the action of the aggressive waters or other liquids.

It is, then, necessary to have it clearly understood that not all pozzolanas and analogous materials behave in the same manner; and from this we shall arrive at the conclusion given later, that it is impossible to find a close relation between the chemical tests and the strength tests of the lime-pozzolana mixtures.

Procedure Followed in Tests

Conforming to the investigations conducted by certain specialists, we began the study of various pozzolanas (Naples gray pozzolana, trass, pozzolana from the Island of Santorin), undertaking to classify them and to express their value in terms of the quantity of soluble silica which they contain; and in doing this we applied the method recommended by M. Baire, considering it the most exact.

Later, after having proved that certain materials obtained artificially do not yield high percentages of soluble silica when subjected to the usual test methods, and, notwithstanding, show affinity for lime, we decided to eliminate almost entirely such determinations, confining our investigation to verified tests, placing the substances under test into contact with lime and determining the quantity which, at various elapsed periods of time, had entered into combination.

Soluble Silica No Criterion

We are of the opinion that soluble silica—or, more properly, those elements that are soluble in dilute hydrochloric acid—are not the ones that determine absolutely the pozzolanic activity of a substance. And this is asserted in view of experimental data, in the belief that the classification of pozzolanas in terms of their percentages of soluble silica must lead to error in many cases. This is true, above all, when we are considering artificially produced materials.

Setting aside the question of determination of the soluble elements, we believed it more rational to test the capacity for absorption of lime by pozzolanas. These tests were classified, in general, into two classes: (1) Physical, including determination of the durability of lime-pozzolana mortars and the impermeability of cement-pozzolana mixtures; and (2) chemical, including determination of the affinity for lime and resistance to attack by aggressive liquids. The relationship, which many who have devoted themselves to this question have endeavored to establish between both classes of tests, is difficult to find in all the series of pozzolanas and analogous materials.

For the reasons pointed out when treating of the manner of behavior, it is perhaps more logical to study these substances in comparison with others taken as types, under similar conditions of experimentation, and approaching as closely as possible to the conditions encountered in the practical employment of pozzolana. But even with the laboratory tests conducted with the view of observing the attack of aggressive liquids on cements and mixtures, it was not possible to obtain the exact conditions encountered in current practice.

For those tests which tended to demonstrate the durability of the lime-pozzolana mixtures, there is uniformity in the method of practical operation. This was not possible to the same extent with those of a chemical character, whose object is to determine the affinity between the substance and hydrated lime.

Many Variations in Methods

These latter tests, derived from those of Vicat, employing a lime solution, have almost as many variations as there are operators to apply them. Besides, the conditions under which the tests have been conducted were quite different, especially the manner in which the pozzolana was employed.

The results are not in accord, even in cases where test conditions were similar, and they do not point to any definite conclusions. The results derived from the tests of Florentin, and from those of Baire (undertaken to determine the soluble silica), are indications—as previously stated—only for certain pozzolanas. In consequence, they can not be recommended, in some cases, when dealing with certain products prepared under known conditions, although the same materials, prepared by other methods, are well known for their beneficial effect on mortars and concretes, because of their integrity in the presence of aggressive liquids.

Present Tendency in Tests

The present tendency is toward the testing of pozzolanas in intimate combination with hydrated lime,[5] the purpose being to determine the quantity of lime that is combined, as well as the physical effects obtained in mixtures of cement and pozzolana, and of lime and pozzolana. These physical effects appear, in many cases, to be the natural consequences of such combinations.

This criterion in the chemical examination of pozzolanas, for the purpose of determining their behavior with air-slaked lime, is also followed by Feret, who modified slightly the method of Dr. Stoepe,[6] a consistent method for determining the silica and the sesquioxides which have entered into combination with the lime during the more or less prolonged contact. This method consists, in general, in mixing intimately equal parts, by weight, of pozzolana and air-slaked lime to form a paste, permitting the mixture to harden in this special condition, pulverizing at the end of certain time-periods parts of these hardened specimens, and determining the proportions of silica and the sesquioxides in comparison with the initial pozzolana, employing the dilute hydrochloric acid method of Florentin. The procedure is long and tedious, more especially for industrial laboratories in which, of necessity, the duration of the tests must be limited to a practical length of time.

Employ Emley Method

For this reason we have conducted our tests by another method, although the information which we seek is the same—that is, the quantity of lime that reacts progressively with the elements in the pozzolana. In this case we applied the method of Emley, a method already being employed for other determinations involved in daily control.

In connection with this method, so well known among cement chemists, there has been raised the question of confusion between free lime and hydrated lime. Certainly, both are present, but the exactness of the method lies in their interpretation.

(The second—and final—installment of this article will discuss the methods employed in testing both natural and artificial pozzolanic materials. — The Editor.)

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[5] E. de Castro—"Report to the Director of Maritime Works of Denmark."

[6] In Revue des Materiaux de Construction, Nos. 281 and 282 (year 1933).

American Chemical Industries Tercentenary

Draws Registration of 5,100, Largest in Society's History—Symposium on Construction Materials

SUCH terms as century, centennial, tercentenary, and the like, always attract attention when they appear in the title of an event, and emphasize its importance. On many counts the title of the recent celebration held in New York by the American Chemical Society, April 22 to 26, was well chosen. The registration for the event was more than 5,100 — more than 50 per cent greater than for any other meeting of the Society.

The convention commemorated the start, in America, of what is now known as chemical engineering—or process engineering. Almost two centuries before portland cement was patented, John Winthrop, the younger, manufactured salt, developed graphite deposits and constructed the first furnace in the colonies for reducing iron ore.

If there had been fifteen representatives of CONCRETE present at the New York meeting, they could have covered the sessions fairly well, but not completely. Nineteen divisions and subdivisions held sessions—not to mention a long list of group breakfasts, luncheons, dinners, and inspection trips.

Probably the sessions most interesting to cement men were a symposium on materials of construction in the building industries, and the sessions of the gas and fuel division. The symposium on building materials was unique in several respects. It was the first symposium on the subject ever held by the Society, and the best given by any organization which has been heard by the writer. Most of the papers did not emphasize chemistry. In fact, a person listening to them without having seen the program might have thought they were being presented by any group of engineers, architects, or contractors. A number of the papers were given by men with admittedly little knowledge of chemistry, including two architects and a code specialist. Cement, concrete, lime, glass, brick, aluminum, steel, lead, paints, and synthetic resins were among the items mentioned. The following is a list of the papers of the symposium:

The Problem of the Building and Construction Industry.

The Evolution of Shelter.

The Correlation and Interpretation of Chemical Developments in Relation to Building Uses.

Production Plus Architect Equals Consumption.

The Relationship of the Building Code to New Materials of Construction in the Building Industry.

Abrasive Products in the Building Industry.

Glass in Building.

Concrete in Modern Home Construction.

Portland Cement as Revealed by High Temperature Research upon Its Components.

Portland Cement and Its Possibilities.

The Plastic Flow of Portland Cement Concrete.

Reactions of Calcium Chloride with Portland Cement Constituents.

Heterogeneous Construction in the Building Industry (Brickwork and the Chemist).

Structural Products in Gypsum.

Waterproof Lime.

Waterproof Masonry.

Calcium Hydrosilicate as Building Material.

Rostone Operations.

Silicate of Soda in the Building Industry.

Fiber Building Boards. Their Manufacture and Use.

Aluminum as a Material for Building Construction.

White Metals in the Architectural Field.

Lead in the Building and Construction Industry.

The Use of Stainless Steels and Vitreous Enameled Iron in Architecture.

The Importance of Arc-Welding to the Building Industry.

Latex Wire.

Urea-Formaldehyde Condensation Resins in the Production of Laminated Sheets for the Building Industry.

The Use of Bakelite Materials in the Building Industry.

The Use of Tar Products for Waterproofing and Dampproofing Purposes.

Built-Up Roofing, Flashings, Roof Drainage, Membrane Waterproofing, and Dampproofing.

Plastics in the Building Trades.

Vaporproofing of Cold Storage Insulation.

Coated Fabric in the Building Construction Industry.

New Products and Problems in the Field of Construction Painting.

Preservatives and Anti-Termite Protection of Timber.

Synthetic Weather.

Cellulated Clay Units.

Building Insulations—Domestic and Industrial.

Effects of Smoke on Building Materials.

Fire Loss Prevention.

Some Practical Considerations in Chemical Plant Construction.

Fire Prevention and Protection in Chemical Plant Construction.

The Problems of the Building Industry and the Future.

At the gas and fuel division sessions, there were numerous papers of interest and value. The outstanding one was *Three Hundred Years of American Fuels,* by A. C. Fieldner. This paper outlined developments in the uses of wood, coal, oil, and gas, and the important and essential place of fuels in American industries.

Plant Closed Eight Years Now Reopening

THE Ragland (Ala.) plant of the National Cement Company, Birmingham, resumed operations recently, after having been closed for eight years. Manufacturing operations were resumed with one of the four rotary kilns installed at the plant, and with three shifts working seven days a week.

Prior to the opening, 130 men were employed in the work of repairing and reconditioning the plant. This work included the pumping of water from the quarry, laying new cross-ties in the quarry tracks, installing new and modern crushers, elevators and conveyors.

The Ragland plant operates under the dry process, with two kilns each 7½ by 125 ft., and two others of the same length, but 9 ft. in diameter. The company manufactures "Coosa" brand portland cement and a higher priced red portland cement. Offices of the company are in Birmingham, in the Martin Building.

New System of Testing Cement

By C. R. PLATZMANN

(*In Cement and Cement Manufacture, March,* 1935)

THE December 1934 number of *Cement and Cement Manufacture* contained an article dealing with the question of an international specification for cement, and with the attendant difficulties. From the tables of specifications of various countries published in your January number it appears that little progress has been made toward this goal. One reason for this is that many small states treat the question as a national one, instead of adopting one of the more important specifications which are known to ensure a cement of high quality. From this point of view the tables are found to contain no fewer than fifteen superfluous specifications. The remainder fall into two groups, based on the English and German specifications, respectively. The basic difference between these is the use of a mechanical method of tamping the test-pieces in the German standard. This divergence is a serious obstacle to the adoption of a common standard, although recently opinion in England has inclined toward the mechanical preparation of test-pieces and the inclusion of compression tests. Even assuming that agreement were possible, however, it would seem that the entire system of specification is due to undergo a fundamental change from the present physical-mechanical basis to a foundation on chemical constitution.

Compromise Not Satisfactory

Before considering this, some of the arguments against the present system may be mentioned. While the manufacturer regards standard tests in relation to works control, the user views them as a criterion of the practical value of cement, and a compromise can satisfy neither. The user is not helped by results which apply to conditions of consistency, etc., which are very different from those of practice. The increase of crushing strength and the change in the relation between crushing and tensile strengths tend toward cement liable to expansion. The test on the 170-mesh sieve is no criterion of fineness. The active fraction of a cement can only be evaluated by means of an apparatus such as the elutriator used by the Associated Portland Cement Manufacturers.

Classify According to Use

A further point is the increasing use of special cements for which the ordinary specifications are inadequate. Thus there is no ready means of determining contraction, which is of importance in connection with concrete roads and cast stone. When large masses of concrete are involved the heat of hydration is important. For such reasons there have recently been recommendations for a system comprising a series of cements. Moncrieff suggests three grades of ordinary portland cement. Kühl proposes classifying cements according to their use, e. g., a cement of high crushing strength for reinforced concrete work, one of high initial strength for road construction, one of low heat of hydration for use in large masses of concrete, and one of low contraction for cast stone. Kühl's proposals are allied to the question of adopting a system of specification based on chemical constitution.

It is only recently that the constitution of portland cement has been definitely settled by means of X-ray analysis, and it may be definitely accepted that the chief constituents are tricalcium silicate ($3CaO.SiO_2$), beta dicalcium silicate ($2CaO.SiO_2$), tricalcium aluminate ($3CaO.Al_2O_3$), and the compound $4CaO.Al_2O_3.Fe_2O_3$. From the work of the United States Bureau of Standards, particularly of Bogue and Lerch, we know that the proportions of these constituents can be calculated from the oxide analysis. The functions of the several compounds are also known. Thus high $3CaO.SiO_2$ content gives high crushing strength, the slower hydrating beta dicalcium silicate gives good long-period hardening properties, and $3CaO.Al_2O_3$, with its vigorous reaction and high heat of hydration, accelerates initial hardening through copious crystal formation, although it can also cause contraction exceeding 7 per cent.

Can Determine Properties

From the constitution, as calculated from the oxide analysis, the properties of a cement can be determined with considerable certainty. It might be argued that such calculations do not indicate the extent to which the lime is combined, but there are today adequate methods of determining the free lime in cement. Further, the heats of solution and of hydration of the individual constituents of cement can be determined by a method published by Bogue and Lerch in the *Bureau of Standards Journal of Research* for 1934. It is therefore now possible to place this chemical method of evaluating cement on a practical basis with a view to a new type of standard specification.

Once this basic principle is admitted, the attainment of international agreement will offer much less difficulty than on the present physical-mechanical system. Setting time, soundness, and strength tests can of course be retained, although these properties would be ultimately determined by the constitutional composition. If, for example, definite composition be laid down for the cements suggested by Kühl, with a limited heat of hydration (i. e., a limited $3CaO.Al_2O_3$ content) for the cement to be used for large masses of concrete, the standard specifications are only a consequence of the basic principle of chemical composition.

In view of the tendency toward a radical change in the standards it is not too much to hope for the early realization of these proposals, which offer both an excellent basis of specification and the possibility of a gradual approach to international agreement.

Chemical Industry Medal Awarded

THE American section of the Society of Chemical Industry announces that the award of the Chemical Industry Medal for 1935 has been made to Dr. Edward R. Weidlein, Director of the Mellon Institute of Research, at Pittsburgh. This award is made annually to a person who has made a valuable application of chemical research to industry, primary consideration being given to applications in the public interest. Presentation of the medal will be made at a meeting of the Society of Chemical Industry in the fall.

How Granulometric Composition Affects Cements

Tests at Bureau of Standards Reveal Influence of Particles of Various Range of Sizes

A STUDY of the granulometric composition of cement and its effect on the properties of pastes, mortars, and concretes, is reported by J. Arthur Swenson, Lacey A. Wagner, and George L. Pigman, in the April (1935) issue of the *Journal of Research* of the National Bureau of Standards.

Study Five Size Fractions

In conducting the tests involved in this study, five laboratory-ground clinkers and one commercial portland cement were separated into size fractions, and studies were made of neat pastes, mortars and concretes prepared from the fractions, as well as from four different blends. The laboratory-ground clinkers were separated into the five fractions comprising the sizes of 0 to 7, 7 to 22, 22 to 35, 35 to 55, and larger than 55 microns. The commercial cement was separated into only four fractions, no separation being made of the material coarser than 35 microns. The four blends ranged in specific surface from about 1,300 to 3,300 cm^2/g. Most of the tests were made both with and without the addition of gypsum.

The fractions of any one cement in most cases showed considerable variations in chemical composition and calculated compound composition. The tricalcium silicate, in general, tends to be more concentrated in the finer sizes, while the higher percentages of dicalcium silicate usually occur in the coarser fractions. The other constituents are about equally distributed.

Coarse Particles Like Sand

It was found that all of the fractions, with the exception of the fine 0-7 micron material, were more or less deficient in the power to hold water and that they were lacking in plasticity and good working qualities. These characteristics ranged from the 7-22 micron fraction, which was not vastly different from a whole cement, to the coarsest fraction, which behaved very much like a fine sand. The 0-7 micron fraction was very plastic, had a high water-retaining capacity, and was also characterized by an extreme stickiness.

The working qualities of the blends ranged from the coarsest blend, which was possibly somewhat more harsh than the average commercial portland cement, to the highest surface blend, which was more plastic and required more water than the ordinary high-early-strength cement. It was found that on the average the amount of water necessary for normal consistency was very nearly a direct function of specific surface. Also, the time of initial set was found to be very closely related to surface.

At one day it was found that strength is directly related to specific surface for both the fractions and the blends. At other ages, when strength was plotted against specific surface, one line was obtained for the fractions and another for the blends. The strengths of the blends were closely related to specific surface at all ages.

Strength Relations

Some good correlations were obtained between strengths and the percentage of hydrous material corresponding to definite depths of water penetration as calculated roughly from the size-distribution data. The fact that the strengths of the fractions, when plotted against the percentage of hydrous material, fell on the same lines as those of the blends showed the relationship to be of a more fundamental nature than that existing between specific surface and strength.

Since a much lower cement-water ratio had to be used in molding the strength specimens from the 0-7 micron fraction than in molding those of any of the other fractions or the blends, the strength data obtained for this fine material were not directly comparable with those obtained for the other fractions or the blends. However, the strength of this fraction was calculated from its contribution to the strengths of the blends, and these calculated strengths were found to be greater at the early ages than the observed strengths of any of the other fractions, and at least as great at the later ages.

P. C. A. Spring Meeting Well Attended

THE Spring Meeting of the Portland Cement Association, held at the Waldorf-Astoria Hotel, in New York, on May 13, 14 and 15, was one of the most largely-attended spring gatherings in recent years.

Reports by the technical problems and conservation committees were the principal features of the second day's sessions. Two papers presented before the mill session were recognized as of far-reaching importance to the industry.

A distinct renewal of interest was displayed in the subject of accident prevention. While the year 1934 recorded an increase in accidents—the first in many years—operating officials seem determined to correct the causes of last year's let-down in vigilance.

Considerable optimism was manifested at the meeting, based not only on the federal government's construction program, but also on the nationwide evidence of an upturn in private construction contracts.

Not So Dumb!

Says a special dispatch from Mukden, Manchuria, to the *New York Times:* As a means of controlling the cement industry in Manchuria the Manchukuo Government has refused to issue permits for the building of new factories or for expansion of the existing plants. The reason for this move is explained by the fact that the government regards the production of cement in Manchukuo to be, at present, sufficient for the needs of the country. The present production is approximately 50,000 tons monthly.

Cement Plant Directory

The AMERICAN CEMENT DIRECTORY, 1935, published by the Bradley Pulverizer Co., Boston, Mass., and Allentown, Penna. Flexible binding, vest-pocket size, 80 pages. Price $3.00.

This is the twenty-sixth consecutive issue of this well-known directory, which contains—as in former issues—names and addresses of cement manufacturing companies in North and South America, names of officers, location of plants, type of process employed, principal equipment, names of brands manufactured, and annual capacity.

Men and Mills

[News of and for Cement Mill Men]

A clearing-house page for all kinds of news about cement men and cement mills. ℂ Readers in all mills, even though not regular contributors, are invited to send in news notes about personal and plant activities that may be of interest or value to the men in other mills.

Arthur F. Miller, well known to the cement industry as a consulting engineer, heads the newly organized Cadillac Engineering and Manufacturing Co., with offices in the United Artists Building, Detroit. The new company is engaged in the design and manufacture of cement mill machinery.

Mr. Miller has been associated with the portland cement industry since 1907. He has specialized in the study and solution of problems in grinding, in heat recuperation, and in the development of special cements. In 1920 he entered private practice as a consultant, and in this capacity he introduced many improvements in plant design, in cement-making machinery, and in manufacturing methods. A well-known clinker cooler was one of his developments during this period.

●

Marquette Cement Manufacturing Company resumed operations at the Cape Girardeau, Missouri, plant April 15, re-employing 400 men. The plant closed February 16.

●

Lowell Burch of New York City, has been elected a director of the North American Cement Corporation to succeed A. M. Tyree.

●

Frank G. McKelvy of Easton, Penna., for twenty-one years vice president in charge of production of the *Alpha Portland Cement Company*, has been elected president.

G. S. Brown, who has been president, has been made chairman of the board of the *Alpha Portland Cement Company*, a position created by a vote of the stockholders.

●

Calaveras Cement Company, San Francisco, reports for the year 1934 a net loss, after all charges, of $8,588, a substantial improvement over the 1933 net loss of $23,372.

●

Lehigh Portland Cement Company resumed manufacturing operations at Mason City, Iowa, on May 20, re-employing 200 men, it has been announced by W. H. Patterson, superintendent.

●

Stockholders and creditors of the *Peerless Cement Corporation*, met on March 20 in Wayne County building, Detroit, to hear the final report of W. C. Russell, receiver.

●

International Cement Corporation's 16th annual report (1934) shows a profit of $666,730 (after deducting reserves for depreciation, depletion and interest on debentures) equal to $1.04 a share common, as compared with a loss of $102,266 for the previous year. Quarterly dividends of 25 cents a share were resumed on the common.

Net profit for the first quarter of 1935 is estimated at $115,601 as compared with $49,896 for the first quarter of 1934.

●

Petoskey Portland Cement Company, Petoskey, Michigan, resumed operations in April, when about 300 employes were called back to their jobs. This plant has been shut down since late last summer.

●

Employes of the *Monarch Cement Co.* plant at Humboldt, Kans., will participate in a nation-wide "June No-Accident Campaign" sponsored by the Portland Cement Association of Chicago.

●

The *Lone Star Cement Company*, Bonner Springs, Kansas, entertained 18 local business men on a trip through the plant recently.

●

Both the Oglesby (Ill.) and the Cape Girardeau (Mo.) mills of the *Marquette Cement Manufacturing Co.* have been awarded the safety trophy for operating during 1934 without accident.

●

The Dixon, Illinois, plant of the *Medusa Portland Cement Company* resumed operations May 1, giving employment to approximately 275, L. E. Smith, plant superintendent, announced recently.

●

Gene Hall, superintendent at *Wabash Portland Cement* plant at Stroh, Indiana, announced on April 30 that the plant, employing about 180 men, will be reopened soon. It has been closed for nearly three years.

●

North American Cement Corporation's report for 12 months ended March 31, 1935, shows net loss of $160,692 after taxes, depreciation, depletion, interest and amortization, etc., comparing with net loss of $734,070 for the 12 months ended March 31, 1934.

●

Pennsylvania-Dixie Cement Corp. report for 12 months ended March 31, 1935, shows profit of $1,174,274 before depreciation, depletion and interest, comparing with profit of $396,528 for the 12 months ended March 31, 1934. After provision for depreciation, depletion and interest, there was a net loss of $743,266 against net loss of $1,549,736 in the preceding 12 months.

●

The Medusa Portland Cement Co. plant at Bay Bridge, is again in operation. One hundred and twenty-five men are re-employed.

●

Lone Star Cement Company has renewed its lease for the entire twenty-second floor, 342 Madison Avenue, New York City, for a long term.

●

The *Monolith Portland Midwest Company* of Laramie, Wyo., has been awarded a contract to furnish 12,000 barrels of cement for the Casper-Alcova project, according to an announcement of the U. S. Reclamation Bureau.

●

National Cement Company, Birmingham, Ala., has called 50 men back to work. Partial resumption of the mill at Ragland, Ala., is planned for the immediate future.

●

The gypsum plaster plant operated by the *Pacific Portland Cement Co.* in the Imperial Valley of California, 18 miles west of El Centro, has opened a new deposit 25 miles from the plant. The new deposit is a high grade gypsum rock, the quarry having been opened along the base for a distance of several thousand feet.

●

Dr. Poul Larsen, famous Danish engineer and leader in the cement industry, died in New York City on May 11 of appendicitis at the age of 76. In 1886 he founded the F. L. Smidth Company, makers of cement machinery. His cement factories were established throughout the world. He was one of Denmark's richest men.

●

There was a sharp improvement in earnings of *Lehigh Portland Cement* in the year ended March 31, when net income amounted to $664,000 against a loss of $434,000 in the preceding twelve months.

●

The Fredonia (Kansas) plant of the *Consolidated Cement Corporation* is again in full production, resuming operations after a quiet period during which time the physical properties were overhauled.

●

John Keese Hallock, special representative and former assistant sales manager, Universal Atlas Cement Company, died May 24.

MILL EQUIPMENT

AERO-VIBE is a new sturdy single-deck screen design announced by Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin, in sizes from 1½ x 3 to 5 x 10 ft., and said to be low priced.

These screens "float in the air" suspended by cables and springs, vibrated by adjustable counter-weighted wheels. They are said to handle medium to fine size commercial materials, either wet or dry in moderate tonnages.

•

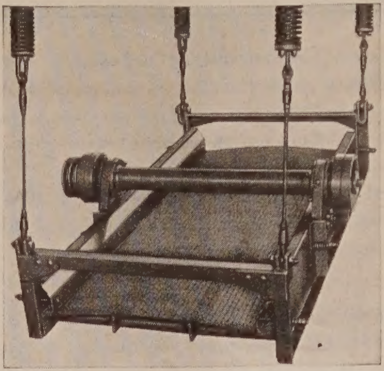
GOODRICH belts made five years ago look like those made to-day, but they're different in 14 ways, according to the B. F. Goodrich Company of Akron, Ohio. Six of these, they say, are improvements in manufacturing process, four in fabric used, four in rubber compounds.

Manufacturers' News

A. W. Robinson, cement plant engineer of the Oliver United Filters Inc., has gone to the Argentine to superintend the installation and starting up of American cement slurry filters at the plant of the Cia Sudamericana de Cemento Portland (Juan Minette & Co.), Cordoba, Argentina.

•

A MOST unusual quarry shot took place at the Giant Portland Cement Company's quarry at Egypt, Pennsylvania, on Wednesday, March 6, according to du Pont. It was probably the first time in the history of the use of explosives in quarry operations that a shot was accomplished by the use of safety materials which made it almost injury-proof. It consisted of the use of *Nitramon* in two of the quarry holes, detonating these with a can of TNT to which cordeau was attached. The blasting cap, the one product of a quick explosives nature, was located on the end of the cordeau some 300 ft. away.



Aero-Vibe single deck screen

It would have been possible, in a shot like this, if anything had gone wrong, to have simply removed the TNT and dug out the *Nitramon* in perfect safety, says the E. I. du Pont de Nemours & Co., manufacturers of *Nitramon.*

Industrial Literature

ACCURATE Weighing of Bulk Cement into truck compartments, batch boxes, stationary or transit mixers is the subject of Bulletin No. 9134 being distributed by Richardson Scale Company, Clifton, N. J.

The use of bulk cement in preparing concrete for the construction of highways, dams, buildings, and large public works projects effects worthwhile economies.

Accurate weighing facilities, however, are required by most specifications. On the other hand, the contractor who complies with approved specifications is protected against losses due to overweighing.

The Richardson semi-automatic bulk cement scale has been specially designed, the company claims, to meet the requirements of approved state specifications and public works projects.

It is built to receive bulk cement from an overhead bin, to weigh it accurately if operated properly by the man in charge, and to discharge it by push button direct from the scale into truck compartments, batch boxes, stationary or transit mixers as each arrives in the proper position beneath, they say.

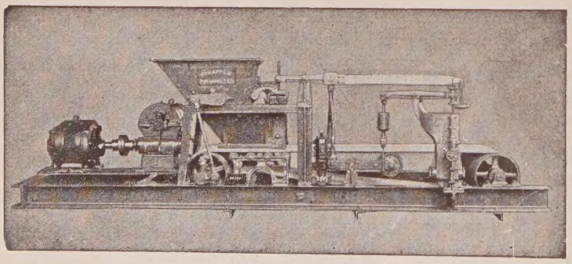
A tell-tale indicator affords visible evidence of each complete weighing cycle—empty hopper; warns the operator when to reduce the flow, when nearing completion of a weighing, and when to close the inlet gate; is equipped with electrical contactors and automatically locks the discharge gate if weighings are not within the prescribed tolerance. By a system of electrical wiring and mercury contactors, the scale is interlocked in all its mechanical features, they say, to ensure the cement being weighed in the correct amount.

•

SPEED reducer catalog No. 1415, with horse power and other engineering data, dimension diagrams, etc., has recently been issued by Link-Belt Company, Chicago. The book covers single, double and triple reduction units of herringbone gear type; also a full line of flexible couplings.

•

MIAG Calcinator is the title of a booklet being distributed by the Bradley Pulverizer Co., New York City, sole agents for this equipment in the United States, Canada and Mexico.



Schaffer Poidometers

are being used by many of the largest cement manufacturers for weighing and proportioning raw and finish materials; also for weighing and feeding coal to dryers. The latest installation being four Poidometers for weighing and feeding clinker and gypsum into Hercules mills at the Iola, Kansas plant of the Lehigh Portland Cement Company.

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